Whether I am speaking as quarterback of this team, or Colonel of the Battalion, I am very proud of my position as head of this research organization with its long and productive history.

And I am happy to join in welcoming these distinguished guests and friends to our Open House at the Agricultural Research Center.

We had three reasons for asking you to join us today in this celebration of National Agricultural Science Week.

First, we wanted you to look with us at what agricultural science is doing for mankind now -- and to see how these efforts will help us to support a better world by the year 2000 -- and beyond.

Second, we wanted to give you a graphic demonstration of our intention to improve and increase the flow of information from the U.S. Department of Agriculture to the public. These exhibits and demonstrations today are examples of our open door policy in action. We plan to implement this policy with a permanent visitors' center so that visitors can come year round and see for themselves what agricultural science is doing to serve them.

Finally, we wanted you to join us in laying the cornerstone for a great new library that will give added support to the progress of agricultural research.

Address by Secretary of Agriculture Orville L. Freeman at the National Agricultural Science Week open house, Agricultural Research Center, Beltsville, Md., September 28, 1967.

As we pursue these three objectives during the day, you will see examples of the agricultural research and science that have helped to lay the foundation for the economic and social structure of this nation.

Agriculture provides the very fundamentals of human existence -- food, shelter, and clothing. Until these fundamentals are provided, no man is free to contribute his efforts to anything else. Without a strong and productive agriculture, the goods and services ... the culture ... the way of life that we know ... could not have evolved.

Agricultural research in this country has more than paid for itself. It would be impossible to calculate the ratio of costs to benefits of the agricultural research that has already made its contribution to men, women, and children everywhere.

Let me explain briefly how this has worked.

Here in the Department of Agriculture, we feel that the job of research is not done until the findings are made known and applied. I am proud of the unique Federal-State partnership in agricultural research and education that is finding solutions to the problems standing in the way of national progress ... and is letting people know what those solutions are.

Agricultural scientists today are probing the basic cell structure of living matter and the fundamental life processes of plants, insects, animals, and man. They are broadening our understanding of our environment so we can modify it for the welfare of mankind.

(more)

But we are not leaving this basic knowledge to gather dust in our laboratories. For more than a century, we have carried the results of our research into the field and seen them put into practice. Our scientists and educators have the time and the patience to show farmers, food processors, manufacturers, and homemakers what they have learned.

As a result, agriculture, our biggest industry, has an enviable record for improving production efficiency. A century ago, 7 million farm workers were needed to feed 31 million Americans. Today, roughly 6 million farm workers feed 200 million Americans, plus 160 million beyond our shores.

Without this explosive increase in productivity, it would have been impossible for the United States to have fed a shattered Europe after World War II, or to have sponsored Food for Peace and Food for Freedom. And without these programs, it is certain that millions now living would have died from starvation.

These are direct benefits of a progressive agriculture. But the indirect benefits were also vitally important to the economic development of our country.

The productivity revolution both released agricultural workers for the industrial revolution and lowered the relative cost of food. As a result, more purchasing power was available for the consumption of industrial goods, starting the United States on an economic climb that is still going on.

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Our experience during the past century underlines a basic truth. We in America have demonstrated that science holds the key to increased agricultural productivity, the solid base upon which all subsequent economic development rests.

In fact, history clearly shows that no nation has moved from chronic stagnation to sustained economic development until it first achieved a subsequent gain in agricultural productivity.

That is why it is so important now that we continue to export our agricultural know-how to the less-developed countries. Their success depends upon their agricultural growth and development.

We are sending our scientists and technicians abroad to share the results of our basic and applied agricultural research. Working with the people in the developing countries, we are adapting this knowledge to the specific problems and needs of those who are trying to feed themselves from their own land.

We are also inviting increasing numbers of foreign technicians to train here under our leading scientists. For example, at the U.S. Salinity Laboratory in Riverside, California, more than 1,600 foreign nationals have learned how to diagnose and correct salt damage to soils, that holds down crop yields in many parts of the world. And more than 50 foreign scientists and scholars from some 30 countries have trained under our crops scientists in the past three years.

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So far, I have mentioned agricultural research as it supports the productivity of the land. But in the more than 100 years of service to people, USDA scientists have contributed to many other aspects of living.

--Our scientists traced the cause of Texas cattle fever to the fever tick, not only paving the way for eradication of a devastating disease but paving the way for the control of such human diseases as malaria, yellow fever, typhus, encephalitis, and bubonic plague.

--Our researchers developed a practical process for commercial manufacture of penicillin during World War II and discovered the high-yielding strain of penicillin-producing micro-organism that is in use today.

--Other USDA scientists showed that dextran, a starchlike carbohydrate, is an excellent blood volume expander that is used to extend the supply of whole blood for transfusions ... a particularly vital discovery in times of national emergency.

--Agricultural research has expanded industries and created new ones with developments such as frozen orange juice concentrate ... dehydrated potato flakes and granules ... wash-wear cottons ... stretch cottons ... and washable woolens that do not shrink.

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And so, when we look at what has been accomplished, we can give agricultural science an A Plus. Certainly agricultural science among all the sciences best deserves the title of "Humanitarian Science." Its goals are inseparable from the deepest goals of all mankind; of all the sciences, it is the one most responsible for the preservation and enhancement of human life upon this planet.

But the press of world events is not going to give us time to pat ourselves on the back for a job well done. The task of agricultural research is just beginning.

In productivity alone, research must continue to find new and better ways to produce the food and fiber for a growing population in the future. But our goal is not just filling basic requirements. We must improve the standards of living for all our people.

We also will need an increasingly efficient agriculture to take advantage of our expanding export markets. Last year, for example, feed grains became our largest single dollar earner of any export, agricultural or industrial. Now that our surpluses have disappeared, farmers will have to become increasingly efficient to meet competitive market demands at home and abroad.

We look to agricultural science to give us better methods for managing natural resources. We are not <u>now</u> doing a good enough job of protecting our soil, water, and forests. And the calls upon these resources will become even greater in the future.

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Agricultural research must find better ways for us to use more water and still keep it free from pollution -- to enjoy our forests and shade trees and still maintain an effective timber industry -- to grow more from our soil and still maintain its fertility.

Agricultural research must find ways to revitalize rural America and improve the quality of American life. We need to find out how to maintain a better rural-urban balance.

We need research studies to shed more light on the migration of rural people to the cities. We know the rates of migration. We know who is migrating -- what age groups. But we don't know the educational level of these people or why they left or where they are going when they leave rural communities and small towns.

In this field of rural-urban balance -- in this field of human resources and the need for rural opportunities -- we are today about where we were 40 years ago in knowing what was needed in breeding seed corn.

We have not even scratched the surface on this type of research and the human need for knowledge is vital.

We do know that people will go where the opportunities seem most attractive. If that is in Los Angeles or Chicago, that is where they will go. We must find ways to provide more opportunities in rural communities ... to make them truly more attractive.

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For the less developed world, agricultural science must find better means to wage the war on hunger. We must find a way to prevent the starvation that is now taking its toll in thousands of lives around the world. We must find a way to alleviate the malnutrition that restricts the capabilities of millions who succeed in averting actual starvation.

The latest World Food Situation Report, "Prospects for World Grain Production, Consumption, and Trade," made certain points evident.

The report estimates that the less-developed countries by 1980 will require between 54 and 58 million metric tons of grain imports, in contrast with about 29 million tons in the mid-sixties. This estimate assumes continuation of the historical rate of increase in grain production -- an increase which in recent years has been a respectable 2½ percent annually.

Only if the less-developed countries could somehow attain a 4-percent increase in grain output annually could they achieve a high enough rate of economic growth to provide their people with adequate diets without food aid. Our economists view any such radical rise as extremely unlikely. Few undeveloped countries have increased productivity so rapidly.

So food aid will continue to be needed ... to buy time for hungry nations to strengthen their ability to feed themselves.

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But we must redouble our efforts to help them to help themselves. One of our current research projects may prove useful in these efforts ... one which you will see illustrated in our exhibits today.

And that is a joint project with the National Aeronautics and Space Administration to combine the techniques of the computer and space age to work for agriculture. We are attempting to perfect the use of remote-sensing methods to detect differences in soil, identify crops and forest trees, and to determine crop condition.

When these methods are in use from an orbiting satellite, we will be able to better help developing countries make efficient use of their land ... or even to use land in areas not yet considered for agricultural production.

Part of the research and much of the planning and direction of research to meet these challenges will be done here at the Agricultural Research Center. We are supporting this effort by the transfer next year of the world's second-largest government library -- and the largest devoted to agriculture and related sciences -- to this nerve center of Department research.

The National Agricultural Library will occupy a new building, on your left almost directly across the main highway from where we are now. I am sure you saw it when you entered the grounds this morning. The architect's model here beside me shows how the 15-story structure will look when it is completed in October 1968.

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At 11:30 this morning, I will lay the cornerstone for this new library, which will replace our outgrown and outdated quarters in downtown Washington. We will transfer a collection that has grown from the 1,000 volumes inherited from the Patent Office in 1862 to more than a million and a quarter volumes today. The new building is designed to accommodate a collection more than half again as large.

The National Agricultural Library shares with the Library of Congress and the National Library of Medicine the responsibility for coverage of the world's scientific literature. It is not unusual for our Library to receive publications in as many as 50 languages from 150 countries in a year. Exchange with institutions throughout the world is the source of three-fourths of the books and periodicals being added to our collection today.

We not only add some 275,000 periodical issues each year by exchange, purchase, and gift, but our staff also handles almost that many requests for loan or photocopy of works on our shelves. The National Agricultural Library serves the entire scientific community -- colleges and universities, research institutions, agricultural industry, and other Government agencies -- as well as our own employees.

In modern quarters, the Library will be able to serve all of these users more quickly and efficiently in an age when agricultural knowledge is in such urgent demand in solving problems at home and abroad.

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We plan to extend to scientists more special services similar to those provided by our Pesticides Information Center. And the new building is designed for future installation of a computerized system of information storage and retrieval that will mesh with similar systems being developed with the Library of Congress and National Library of Medicine.

The broadening of services by the Library is part of a general mobilization of the Department's scientific resources to build the kind of agriculture our country will need during the remainder of this century.

The Department and the State Agricultural Experiment Stations have joined to develop this last year a comprehensive plan to guide the direction our research should take. This long-range study of agricultural research needs provides answers to three basic questions:

What knowledge do we need to get from where we are to where we want to be in the year 2000?

How much of this knowledge is likely to be produced by our current research programs?

And how should we change what we have been doing -- where should we put more emphasis, where less -- to fill the gaps in needed knowledge?

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We then used the long-range study as a basis for setting research objectives to be reached in the next year, within 5 years, and by the year 2000. Our scientific objectives, of course, are based on the knowledge required in achieving the long-term goals of the Department as a whole.

These goals are expressed in terms of a common theme, Agriculture/2000, that looks to the future in our major areas of responsibility:

* Communities of Tomorrow -- an environment for better living and a revitalized rural America.

* Resources in Action -- wise care and use of water, land, and timber.

* Growing Nations -- New Markets -- trade and aid, with emphasis on victory over hunger.

* Income and Abundance -- parity of farm income, continued food abundance, and a rising level of nutrition for consumers.

* Knowledge for Living -- information and services that will improve the quality of American life.

* Science in the Service of Man -- the miracles we can expect from agricultural research.

(more)

Together, these goals express a commitment by the Department to use its wide and varied resources in making America a more productive and satisfying place to live during the rest of this century.

The theme of our open house, Agriculture/2000: Science in the Service of Man, spotlights the role of research in carrying out this commitment. The exhibits you will see today are designed to give you some idea of the revolutionary developments that may be expected in the future.

And I hope this will be the first of many visits. I hope you will visit the Agricultural Research Center again, and that you will bring your associates and friends. In the past, we sometimes have not been able to accommodate all of the groups that wished to visit our laboratories. But when we establish our visitor center here, we will be able to give more people a more informative picture of what we are doing here.

I am proud of what our scientists are accomplishing, and I know that you will be, too.

It is now my pleasant task to open this exhibition for your inspection.

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USDA 3072-67

LIST OF PUBLICATIONS FOR CONSUMERS

UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural Research Service

LIST OF PUBLICATIONS FOR CONSUMERS

Food and Nutrition

GS-1 Nutrition...up to date, up to you. Reprint from G-1 28 pp. Rev. 1960.
G-1 Family fare...food management and recipes. 96 pp. Rev. 1960.
G-8 Home canning of fruits and vegetables. 32 pp. Rev. 1965.
G-10 Home freezing of fruits and vegetables. 48 pp. Sl. Rev. 1967.
G-13 Food for families with school children. 23 pp. Rev. 1963.
G-17 Food guide for older folks. 16 pp. Rev. 1963.
G-36 Peanut and peanut butter recipes. 20 pp. Rev. 1966.
G-43 Money-saving main dishes. 46 pp. Rev. 1966.
G-56 How to make jellies, jams, and preserves at home. 30 pp. Rev. 1967.
G-69 Home care of purchased frozen foods. 6 pp. 1960.
G-70 Home freezing of poultry. 24 pp. Rev. 1964.
G-72 Nutritive value of foods. 30 pp. Rev. 1964.
G-74 Food and your weight. 30 pp. Rev. 1964.
G-77 Family food stockpile for survival. 16 pp. Rev. 1966.
G-78 Storing perishable foods in the home. 12 pp. Rev. 1966.
G-85 Food for the young couple. 16 pp. 1962.
G-92 Making pickles and relishes at home. 32 pp. Rev. 1966.
G-93 Freezing meat and fish in the home. 23 pp. Rev. 1964.
G-94 Family food budgeting...for good meals and good nutrition. 16 pp. 1964.
G105 Vegetables in family meals: A guide for consumers. 32 pp. 1965.
G106 Home canning of meat and poultry. 24 pp. 1966.
G110 Poultry in family meals: A guide for consumers. 30 pp. 1966.
G112 Cheese in family meals: A guide for consumers. 22 pp. 1966.
G118 Beef and veal in family meals: A guide for consumers. 30 pp. 1967.
L268 Eat a good breakfast...to start a good day. 7 pp. Rev. 1965.
L278 Tomatoes on your table. 20 pp. Rev. 1964.
L293 Sweetpotato recipes. 12 pp. Rev. 1964.
L424 Food for fitness...A daily food guide. 8 pp. Rev. 1967.

Financial Management

G-98 A guide to budgeting for the young couple. 16 pp. 1964.
G108 A guide to budgeting for the family. 14 pp. 1965.

Textiles and Clothing

G-59 Simplified clothing construction. 32 pp. Rev. 1965.
G-62 Removing stains from fabrics: Home methods. 30 pp. Rev. 1964.
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G-97 Sanitation in home laundering. 8 pp. Rev. 1964.
G107 Clothing repairs. 32 pp. 1965.

Housing and Household Equipment

G-32 Washing machines...selection and use. 22 pp. Rev. 1961.
G-48 Home freezers...their selection and use. 22 pp. Rev. 1964.
G-60 The Beltsville kitchen-workroom...with energy-saving features. 14 pp. 1958.
G-99 Planning bathrooms for today's homes. 20 pp. Rev. 1967.
G100 Equipment for cooling your home. 8 pp. Rev. 1965.
G101 Home laundering: The equipment and the job. 24 pp. Rev. 1965.
L463 Beltsville energy-saving kitchen. Design No. 2. 4 pp. Rev. 1963.
M924 1-bedroom frame cabin. (Plan No. 5828). 2 pp. 1963.
M928 Frame 2-car garage. (Plan No. 5929). 2 pp. 1963.
M933 3-bedroom farmhouse...with Beltsville energy-saving kitchen-workroom, Design No. 1. 2 pp. 1965.
M1001 Solar-type cottage. (Plan No. 7148). 2 pp. 1965.
M1047 Picnic shelter. (Plan No. 5995). 2 pp. 1967.
M1050 1-bedroom masonry construction cabin. (Plan Noo. 5968). 2 pp. 1967.

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G-50 Cooking with dried egg. 24 pp. 1956. 15¢
L518 Beltsville energy-saving kitchen. Design No. 3. 8 pp. 1963. 5¢.
HERR-32 Pattern alteration. 38 pp. 1965. 30¢

House planning aids:
M933 U-shaped kitchen arrangements. 4 pp. 1963. 5¢.
M934 Broken-U Kitchen arrangements. 4 pp. 1963. 5¢.
M935 L-shaped kitchen arrangements. 4 pp. 1963. 5¢.
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M944 Corner storage in kitchens. 4 pp. 1963. 5¢.
M960 Dining areas. 4 pp. 1964. 5¢.
M988 Bathrooms. 4 pp. 1965. 5¢.
M1002 Workrooms. 4 pp. 1965. 5¢.
M1004 Bedrooms and clothes closets. 4 pp. 1965. 5¢.

Chart. Food for fitness...A daily food guide. (Wall chart 17-1/2 x 23-1/2 inches). 1958. 15¢ per single copy or $9.00 per 100 copies).

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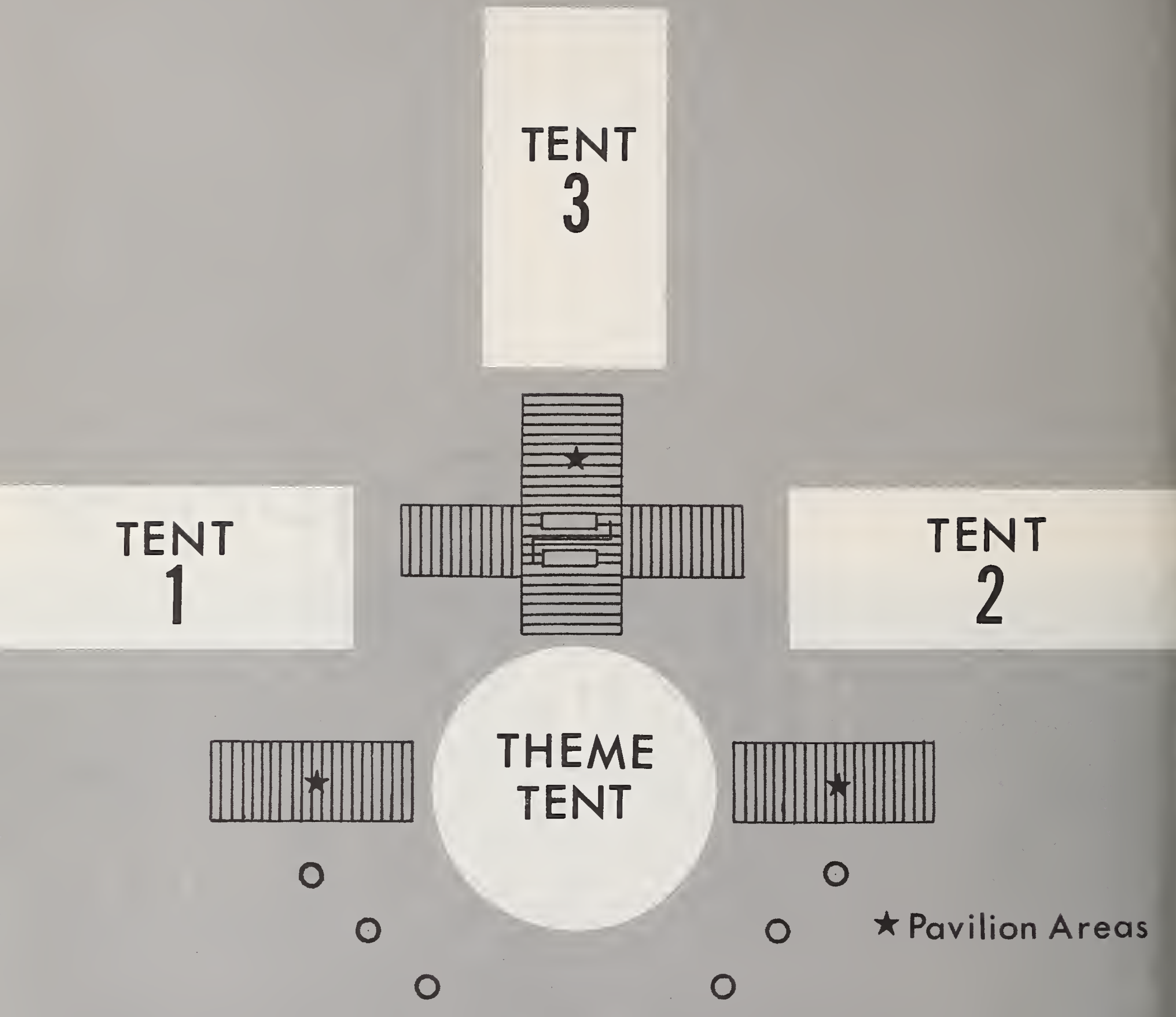
Open House Exhibit Guide / September 28-30, 1967

Science in the Service of Man

U.S. Department of Agriculture

AGRICULTURE 2000



COOPERATING U.S. DEPARTMENT OF AGRICULTURE AGENCIES

- *Agricultural Research Service*
- *Consumer and Marketing Service*
- *Forest Service*
- *Soil Conservation Service*

THEME TENT

"AGRICULTURE/2000: Science in the Service of Man"—Dramatic photographs illuminate the story of ten major objectives of agricultural science in the Department.

- **Agricultural Science Produces More Plants, Better Plants**—Geneticists, plant physiologists, entomologists, and other specialists develop hardier, more productive food plants and seek new ways to conquer the pests which threaten them.

- **Agricultural Science Improves Animal Production**—Breeders, veterinarians, chemists and representatives of many other disciplines conduct research aimed at improving meat animals, milk and milk products, poultry and eggs, and wool.

- **Agricultural Science Fights Environmental Pollution**—Dealing with the threat of environmental pollution—through contamination of air, soil, or water—is a constant occupation of agricultural science.

- **Agricultural Science Helps Feed a Hungry World**—American scientists are anxious to share with the developing nations the scientific principles which have made American agriculture second to none in the world.

- **Agricultural Science Beautifies America**—USDA scientists, through research on shade trees, ornamentals, and flowering plants, are contributing immeasurably to America's beautification program.

- **Agricultural Science Protects Our Food Supply**—Agricultural science helps protect America's food supply by keeping foreign pests out of our country; by moving quickly to find cures for and then to eradicate animal and plant diseases, and by controlling insects, weeds, nematodes, and other harmful pests.

- **Agricultural Science Develops New Products**—Utilization laboratories have developed many new products—including full flavor frozen apple juice, frozen orange juice, mass-produced penicillin—and new ones appear each year.

- **Agricultural Science Serves the Consumer**—USDA laboratories aid the consumer in countless ways—in nutrition, in improving transportation and marketing, in providing food grades and standards, in protecting the market quality of food.

- **Agricultural Science Conserves Our Natural Resources**—Preservation and conservation of our priceless natural resource—our soil, water, forests—is the ceaseless task of researchers, foresters, and trained conservationists in USDA.

- **Agricultural Science in the Space Age**—The application of new space age technology to agriculture may help solve the world food shortage by keeping nations posted on the condition of their food crops and warning them of impending trouble.

PAVILION EXHIBITS

Exhibit A: Morlam

"Morlam" is a new strain of sheep that produce lambs 50 percent more frequently than other strains. Morlam ewes produce a crop of lambs every 8 months — three times in 2 years—compared to once every 12 months for ewes in the normal farm flock.

Top Morlam ewes have produced two lambs per pregnancy or six lambs in 2 years. Agricultural Research Service scientists developing the strain hope that multiple births can be made a Morlam characteristic through selective breeding. They also want to develop in the strain such economically important characteristics as long wool, hornlessness, and white, open faces.

Exhibit B: Fat and Lean Hogs

Like lean humans, lean hogs are also "in." Agricultural Research Service scientists have shown that a well-proportioned, lean hog produces more desirable meat than the fat hog.

Selective breeding for low back-fat thickness has helped researchers produce a hog that will produce better pork on less feed than the conventional hog. The carcasses produce more lean cuts than fat-type carcasses.

For the consumer, this longer, thinner hog with less backfat means more lean and less fat on the dinner table. And by putting the meat on with less feed consumption, the long, lean hog helps the farmer keep his costs down.

Exhibit C: El Toro

El Toro is an 11-year old steer that aids Agricultural Research Service scientists in their research. El Toro has a fistula in his rumen, or largest stomach compartment. The fistula is a surgically-installed opening through which scientists take microbiological samples of the animal's rumen contents for laboratory study.

Using El Toro—and other research tools—ARS scientists are studying how feed is digested in the rumen, the role saliva plays in digestion, and other things about beef cattle. For example, closely related to this work are studies they are conducting to perfect animal feeds containing non-protein nitrogen.

Exhibit D: Beef Calves

Identical twin Angus cows are helping Agricultural Research Service scientists get basic information on the dietary needs of ruminant animals for growth, reproduction, and lactation. One of the cows is on a diet of natural feeds; the other hasn't had a mouthful of natural feed since she was weaned.

How is this helping scientists? Comparing the identical twins' reactions to their respective diets allows scientists to determine more quickly the precise dietary needs of ruminant animals.

Identical twins develop from a single fertilized cell, have common inherited characteristics, and react in much the same way. They also permit research at less cost because comparisons are equal to comparing many unrelated animals.

Exhibit E: Lorna—Star of Energy Metabolism Laboratory

Dairy cows kept in plastic chambers are helping Agricultural Research Service scientists develop new ideas for dairymen. ARS

scientists place a healthy cow in an airtight, individual, plastic chamber to get precise data for a variety of purposes. Over a given period, everything — food, air, water intake, milk, waste production, and the like — is measured.

Tests using the airtight plastic chamber and other methods are leading to far-reaching changes in dairy nutrition concepts. The world's most fully automated energy metabolism laboratory for evaluating feeds and animal requirements is located at Beltsville. Scientists here are among the world's leaders in animal nutrition.

Exhibit F: Chicken-Quail Hybrid

A successful cross of a Dark Cornish rooster and a Japanese quail hen by artificial insemination has produced a chicken-quail hybrid bird that can reproduce. However, the products of the hybrid birds are all males and are sterile. The chicken-quail cross is about half way between the parents in size, weight, age at maturity, and in other characteristics. If the new birds can be treated with hormones to make them fertile, they may provide scientists with a tool to control and direct the evolution of better birds toward the service of man.

Exhibit G: Parthenogenetic Turkeys

How many turkeys does it take to produce more turkeys? Just one! At least that is the case at Beltsville where ARS scientists have discovered that embryos can develop in unfertilized turkey eggs. By selective breeding, the number of eggs showing parthenogenetic development increased, and hatching success has been improved. These turkeys, possessing only those genes (units of inheritance) they receive from their mother, show promise as research tools in scientific studies of human tissue grafting.

Exhibit H: Better Bees for Better Crops

Honey bee colonies are kept in both glass and conventional wooden hives for studies on how man may best use these beneficial insects. Bees are important for much more than the honey and wax they produce. They pollinate billions of dollars worth of crops—alfalfa, apples, pears, cherries, and many other fruits, vegetables, and forage crops. Scientists are studying bee breeding to develop better strains for good pollination, disease resistance, a gentle temperament, hardiness, and other useful qualities. Scientists are also developing ways to overcome diseases and other natural enemies of bees. Finding better ways to manage colonies — involving housing, equipment, food, and other needs of honey bees—is another goal of the scientists.

Exhibit I: What Makes a Steak Tender?

What makes beef tender? Two important factors are the age of the animal and the aging of the carcass. But what is the best age for slaughter and exactly how long should the carcass be aged? To find the answer, tests are being made with Black Angus steers between 6 months and 7 years old. Samples are evaluated by taste panels and by mechanical instruments to measure flavor and tenderness. Researchers are also evaluating the effects animal age and carcass aging have on the physical and chemical properties of the meat.

Exhibit J: A Visual Test for Wheat Quality

What can you do with a bushel of wheat? Grain quality investigations are developing methods and techniques for evaluating the quality of grain and grain products so millers will know how to use a given lot of grain in the most efficient way.

Because the quality of bread flour is largely controlled by the amount of protein in the

wheat it is made from, quick and accurate evaluations of protein content are vital.

A new method has been developed that measures the light reflected from a disk made with a sample of flour. This figure can be converted into a protein content measurement.

Another recent improvement is a grain counter which actually counts a 30-gram sample of grain. This count then can be calculated to predict the volume of flour that will be produced by a bushel of the grain.

Exhibit K: New Trees and Shrubs for Beautification

A primary objective of research at the National Arboretum is to develop new trees and shrubs that are suited to particular environments. For example, work is being done to develop hardy trees that are particularly well adapted to the unfavorable conditions of our city streets. Hardiness was also important in developing a variety of crapemyrtle able to withstand the rigors of northern winters.

Researchers are also developing landscape trees and shrubs with greater aesthetic appeal. They look for bigger and more attractive ornamental fruit, more striking flower color, stronger fragrance, and more desirable growth habits. The aesthetic appeal of High Light, a new variety of holly, is due to the vivid contrast between the light green of the new growth and the dark green of the old growth.

Exhibit L: Giant Plow

To help assure food needs of the future, ARS scientists are converting some 250,000 acres of low-producing "slick-spot" soils of the west into high-productive cropland. The "slick spots" consist of naturally occurring saline-sodic soils, which occupy 10 to 50 percent of fields on steeper benchlands in Idaho and Oregon. They are so-called because the soil surface is slick and shiny when wet. Moisture penetrates them very slowly, and farming operations are delayed because the soils are slow to dry out. Deep plowing to a depth of 30 to 36 inches with specially designed tillage tools brings up and incorporates gypsum and calcium carbonate into the surface soil. The calcium displaces the sodium, coagulates the soil, and helps increase moisture movement from leaching away excess sodium. Deep plowing increases crop yield on slick-spot areas five to sixfold.

Exhibit M: Recording Water Use

The modern farmer can no longer depend on a "probability of rain" to meet his water needs.

An adequate supply of water is essential to the farmstead. Automatic running-water systems . . . more water-using equipment . . . new uses for water . . . higher standards of sanitation . . . all are continually increasing the demand for water — both in quantity and quality.

USDA's Agricultural Research Service engineers are developing automatic systems and techniques to get up-to-date information on the patterns of use, rates of flow, peak rates, pressures, temperatures, and quality of water used on the farmstead and in the farm home. Such information will guide farmers in planning simpler, more reliable, and less costly water systems. It will guide manufacturers in building appliances and equipment that use water. Government agencies that write and enforce sanitary codes will also use this information.

TENT NO. 1

Exhibit No. 1

Seeds—Man's Eternal Provider

Seeds are man's eternal provider. They produce the raw material for life, including food, fiber, medicine, and many other products used by man. Most plant improvements made in the United States can be traced to introductions by plant explorers who are constantly searching the world. Scientists use plant collections to breed improved varieties and to find and develop new crops. Because most of our important crops originated in other parts of the world, the continuing task of assembling and maintaining plant germ plasm has become a far-ranging activity of the USDA.

Exhibit No. 2

Taming the Wild Blueberry

Most of our crops have been modified by breeding to increase their versatility as food, feed, or industrial products. Blueberries are a good example. Plant breeders began improving outstanding wild blueberry species through a long-range program of crossing and selecting. Through their efforts, the blueberry has changed from a wild plant that produced a few scraggly fruits to a commercial plant that produces an abundance of big, tasty berries. Although cultivated blueberries were practically unknown 45 years ago, they produce a crop valued at about $20 million annually. Because genetic improvement never stops, blueberry breeders are still working to make blueberries even better. Through hybridization, they hope to produce berries with greater drought and disease resistance, heat tolerance, winter hardiness, uniform ripening, and very early maturity.

Exhibit No. 3

Nonchemical Control of Insects—Tomorrow's Weapons

Tomorrow's war on insect pests will be fought with nonchemical weapons. ARS scientists are now developing: disease-resistant crop varieties, sex attractants, sterilization, light, and natural enemies. The hornworm, a tomato and tobacco pest, may be lured to its death by traps that combine ultraviolet light and sex attractants. Large numbers of sterilized insects, which mate with the natural population and produce unhatchable eggs, may be released. Mass rearing of natural enemies—such as mosquito-size wasps that attack insect pests but not man, animals, or crops—is now being tested. Viruses and other diseases that kill only insect pests are also being produced in the laboratory and tested in infested fields.

Exhibit No. 4

Resistance Makes the Difference

Breeding plants for resistance to insects and diseases is a continuous battle. On one side is nature's creation of new pests or new forms of old pests. On the other side is man's search for pest-resistant plant varieties.

The alfalfa weevil is the major insect problem of alfalfa—our most important forage crop. After screening thousands of plants, sci-

entists began developing plants resistant to the weevil. Their goal—the release of a resistant alfalfa variety in 2 to 4 years.

Another example, and one that produced an unexpected bonus, is breeding for rust resistance in oats. The bonus is the possibility of higher protein and better-yielding oats, an extremely important development in a world short of food. Wild species of oats from Israel have good resistance to rusts, the most destructive disease of oats in this country. While working to breed this resistance into our commercial oats, the scientists found that some wild oats have a high protein content—up to 30 percent, compared to 19 percent for our best varieties. They also have larger seeds, which could mean better yields. Scientists are now working to transfer these characteristics from the wild oats into our commercial varieties.

Exhibit No. 5

Science Is Finding Better Ways to Battle Weeds

Weeds are also plants. The unwanted ones. Like other plants, weeds need sun, water, and nutrients to grow. And they steal these life-giving resources from our more productive plants. They cost the farmers and homeowners billions of dollars each year. Scientists believe the cost in both time and money can be cut, and they are working toward this goal.

Science has already presented farmers with sophisticated weed control methods; science has also given homeowners simpler weed control methods. Simple or sophisticated, the basic idea is the same—safe and effective ways to do away with weeds.

Exhibit No. 6

Automation in Planting and Harvesting

Dramatic accomplishments in planting and harvesting crops mechanically are taking place in the United States—as increased costs and labor shortages become more critical. Machines now being developd should boost farm efficiency by doing five planting jobs at once. Other sophisticated machines, already developed, have taken practically all hand labor out of harvesting cotton, forage, and feed and food grains. Machines for harvesting sweet corn, tomatoes, sweet peas, and cucumbers often materially reduce the cost of producing these crops. Mechanized harvesting of fresh-market crops like apples, oranges, and grapefruit is moving ahead rapidly.

No one can accurately forecast the outlook for mechanical handling of crops. Refinements in planting machines and new cultural practices may make it possible to plant and cultivate a crop by remote control. Helicopters may someday pollinate and prune orchards. Today's harvesting aids—vibrators and power ladders—may be supplemented by mechanical aids for selective picking. These could include charges of direct-current electricity to release mature oranges, and photo-electric eye machines to distinguish the white spears of asparagus.

Exhibit No. 7

How Does Life Begin?

How does life begin? What biological processes occur when an egg becomes a chicken? An egg goes through many stages of development during the 21 days it takes to hatch. After the fertilized egg divides and forms an embryonic disc, blood forms. The heart develops and begins to pump blood through the egg-chicken body. The head forms and then the eyes, wings, and legs develop. Finally feathers appear and the chick begins to peck its way out of the protective shell.

Exhibit No. 8

More Meat on Your Pork Chops

Today's pork chop is meatier and has much more lean than yesterday's. The same kind of improvement has been made in other meats and animal products. How? Through breeding.

Breeding for certain desirable traits has produced a cornucopia of high-quality animal products. U.S. Department of Agriculture breeding studies have given us today's meat-type hog, superior beef cattle, increased milk production, heavier lambs, finer wool, and other livestock improvements.

USDA began basic livestock genetics studies more than a half century ago. Today USDA's Agricultural Research Service continues the research. Two basic research laboratories are devoted exclusively to this work, and cooperative programs with States are conducted across the Nation.

Exhibit No. 9

How Does A Cow Utilize Feed?

An important activity of the Agricultural Research Service is that of analyzing feeds to determine their value. For dairy farmers this research means better milk production at less cost. More efficient feeding is the goal.

This kind of research was started at the turn of the century. U.S. Department of Agriculture scientists have led in developing net-energy concepts for gaging feed values. The world's most fully automated energy metabolism laboratory for evaluating feeds and animal requirements is located at Beltsville.

To determine the value of feeds for dairy cows, scientists place a cow in a plastic chamber where every bit of feed, air, and water she consumes is measured. They also measure every bit of milk, waste, and gas she produces. This comprehensive data reveals how much feed energy is given off as liquids and gases, how much is used for body maintenance, how much is deposited as meat and fat, and how much is finally available for milk production.

Exhibit No. 10

We Must Save Plant Proteins for Humans

Agricultural Research Service scientists are testing beef cattle on feeds containing non-protein nitrogen. They have two objectives: Producing marketable beef cattle as efficiently as possible, and freeing protein used in animal feed for human consumption.

Cottonseed, soybeans, and other high-quality protein products are presently used as supplements in animal feeds. Scientists have known for some time that ruminant animals—such as cattle and sheep—could get part of their needed nitrogen from nonprotein nitrogen sources. Now it appears that beef cattle are even less dependent on protein sources of nitrogen than was supposed.

Beef cattle, and perhaps other animals, may be able to achieve good, efficient growth on a complete nonprotein nitrogen diet. If the nonprotein feed is satisfactory, huge amounts of high-quality protein can be diverted from animal feeds to use in filling the world protein gap.

Exhibit No. 11

New and Better Uses for Wood

The Forest Products Laboratory of the Forest Service is a national research laboratory with headquarters in Madison, Wis. It conducts research to increase the serviceability of wood products, develop new and improved uses for wood, and augment the usefulness and quality of all wood species. Scientists work on a variety of problems in every part of the country, applying their knowledge and skills on behalf of producers and consumers of forest products. The Forest Products Laboratory helps

in conserving our natural resources, and at the same time, benefits the consumer.

Exhibit No. 12

Soil Surveys Assist Site Planning

Soil surveys can save you money, time, and material. They show the location and extent of the different kinds of soil within a geographical area—usually a county. Surveys can be interpreted to show the suitability of land for use as building sites, parks, roads, forest preserves, or cropland.

Soil surveys are made by the Soil Conservation Service, USDA, in cooperation with other Federal and State agencies. Soil scientists examine the soils acre by acre and record their findings on aerial photographs, or soil maps. The maps become part of the soil survey, which also includes descriptions of all soils found in the area.

TENT NO. 2

Exhibit No. 13

Changing Color of Flowers

Attractive flowers are more than just pleasing to the eye—they hold a highly complex mystery that scientists are just beginning to unravel. Color is the most important component of beautiful flowers. Flower color depends mainly on the interaction of three factors—anthocyanins (chemical compounds that form pigments), acidity, and metals. The pigment of the blue cornflower and the pigment of the red rose are derived from the same anthocyanin. Unstable pigments can shift from blue to red or even fade out altogether—depending in part upon the alkalinity or acidity of the plant tissue. When scientists learn more about manipulating and stabilizing pigments, unusual flowers such as blue roses will become a reality.

Exhibit No. 14

Future Plants for Your Garden Through Exploration

Many of the ornamental plants now grown in the United States originated in other parts of the world and can be traced to a plant explorer. Although modern transportation speeds the shipping time from the sources of these garden plants, political situations and plant quarantines have all but stopped exploration by private institutions and individuals. These obstacles led the Agricultural Research Service and Longwood Gardens, Kennett Square, Pa., to develop a joint exploration program for ornamental plants. Since 1965, 10 exploration trips have been made by ARS-Longwood.

Under this program, plant scientists explore remote regions of the world for new and exotic plants and seeds, collect breeding stocks from countries that have previously contributed important ornamentals, and survey foreign botanic gardens for improved varieties.

Collecting the plants is only part of the job. Once here, they are widely tested for adaptation and ornamental potential and for possible use as breeding stock. These tests tell the story—which ornamentals are suited for U.S. gardens.

Exhibit No. 15

Tailormade Plants Through Chemicals

In the future, scientists hope to double farm productivity without increasing the amount of land by one acre. Key elements in making this possible are chemical growth regulators that produce a compact plant with twice as much food potential as plants now cultivated. Along with compact growth, these chemical regulators promote dormancy, disbudding, pruning, and early flowering. Thus, we will also have ornamentals that flower when we want them to, mature more quickly, and exhibit other desirable features.

Exhibit No. 16

Insect Resistant Packaging

Stored-product insects can attack cereal food products from the moment the products leave the processor's plant until they are consumed. The problem becomes critical when foods are shipped to some of the remote de-

veloping countries. ARS entomologists, working in cooperation with manufacturers of multiwall paper bags, developed an insect-resistant package that protects against infestation from processor to consumer. It is a tightly-constructed bag with an insect-repellent coating on the outside layer. The single greatest use of the package has been to transport over 300,000,000 pounds of a high-protein blended corn product to 90 countries in less than one year. Not one complaint about infestation has been received.

Exhibit No. 17

USDA Research Around the World

Foreign agricultural research is helping U.S. agriculture and—at the same time—is helping other nations improve their own agriculture. This research is financed with local currencies paid to the United States for sales of food and feed under Public Law 480.

Since 1958, over 900 P.L. 480 research grants have been awarded in 30 countries. Administered by the U.S. Department of Agriculture, this program utilizes the talents of thousands of foreign scientists and technicians in providing knowledge for the worldwide war on hunger.

Exhibit No. 18

Foods for Developing Countries

ARS scientists have developed inexpensive, high-protein plant foods that can help developing countries where meat, eggs, milk, and other animal protein foods are scarce. Many of these new foods are also reaching the American consumer in mixes, snacks, and specialty foods.

Cottonseed, peanut, and soy flours can be used in beverages, soups, stews, curries, breads, and cookies. Beverages similar to milk in taste and nutrition have been made from a blend of corn, soy, and milk, and from a dried mixture of soy flour and Cheddar cheese whey. The ancient wheat food, bulgur, has been made attractive and acceptable around the world through an ARS-developed process. In the laboratories, visitors and students from other countries judge ARS-developed protein foods for acceptability in their countries.

Exhibit No. 19

Innocent Items Hide Hitchhiking Foreign Pests

Agricultural quarantine inspectors at United States ports protect the Nation's food, forest, and ornamental resources against damaging foreign plant and animal pests. These invaders include insects, snails, and plant and animal diseases. In their work the inspectors often employ a modified funnel to find foreign plant pests in straw, soil, or grain residues from ships' holds. A simplified version of this Berlese funnel has been developed for student use in classrooms or in Science Fairs. An exhibit of equipment and unusual souvenirs shows how inspectors work and how viewers themselves might, as travelers, innocently bring foreign pests into this country.

Exhibit No. 20

Will We Still Be Eating Meat in the Year 2000?

How do you solve an animal health problem? With the research approach. Almost all problems of animal health—such as poisons or diseases—require many different scientific disciplines. These include:

Chemistry — study of chemical actions in animals.

Parasitology — study of parasites in animals.

Virology — study of viruses and their effects on animals.

Toxicology — study of poisonous materials and their effects on animals.

Pathology — study of changes in animals caused by diseases and parasites.

Bacteriology — study of bacteria and effects on animals.

Immunology — study of ways to protect animals through vaccinations.

These areas of science are used by USDA animal disease researchers to prevent animal losses and provide more food for the world's rapidly expanding population.

Exhibit No. 21

Stamping Out Animal Diseases—for better food at lower cost

USDA's Animal Health Division works to prevent interstate spread of animal diseases. It cooperates with the States and territories in the control and eradication of animal diseases and vectors. It inspects animals and animal products entering the United States, to prevent entry of animal diseases and vectors, and it certifies disease-free status of animals and animal products being exported. USDA is charged with safeguarding the humane handling of laboratory animals intended or used for research. It cooperates with civil defense agencies and handles the radiological monitoring of our animal food supply.

Exhibit No. 22

How We Protect Our Crops From the Medfly

The Mediterranean fruit fly program demonstrates how USDA's Plant Pest Control Division locates, contains, and controls or eradicates plant pests.

The Medfly is a destructive fruit and vegetable pest. Five times it invaded the United States; each time it was destroyed.

The Division maintains a "warning fence" of baited traps. When an invasion is detected, Federal and State officials seek out the pest and regulate the movement of contaminated commodities.

A mixture of bait and 2 ounces of pesticide is sprayed on each infested acre. This treatment eliminates the fruit fly without injuring humans, animals, or fish.

PPCD fights many of the other major insect pests threatening America's food supply.

Exhibit No. 23

What's New in Clothing?

ARS scientists have developed a finish for woven and knitted wools that make machine washing possible without shrinkage or matting. It is now used by industry to make ladies' knit dresses, ladies' and men's suits, and children's clothing. Another process imparts a durable crease to worsteds, now being used in some military uniforms.

ARS researchers helped develop wash-wear cotton and stretch cotton. More recently they have developed a treatment to give cotton garment-life durable press. Now on the market are dresses, skirts, men's and boys' slacks, jackets, lingerie, and sheets with durable press.

A flame-resistant treatment for cotton is now being used in uniforms for fire fighters and in industries where protective clothing is needed. Other treatments give cotton resistance to soil and wear.

With an improved process for tanning, leather garments can be laundered without affecting their softness and beauty. Coats, dresses, and gloves are now being made of leather so treated.

Exhibit No. 24

What's New in Foods?

ARS utilization scientists constantly work with industry to develop new food products that are easier to prepare, more nutritious, more flavorful, or more attractive.

For weight watchers, the scientists have developed peanuts with up to 80 percent of the oil removed, and a low-fat, high-protein cheese that tastes like Cheddar.

For the busy housewife who wants to save time and work in food preparation, there are flakes to make mashed sweetpotatoes and sweetpotato pie; apple flakes that make applesauce; "explosion puffed" dehydrated fruits and vegetables that cook in 5 or 6 minutes; and orange and grapefruit crystals to make flavorful juice.

A new method of processing dried fruits costs less and gives better flavor. It permits the drying of such "undryable" fruits as melons, papaya, and guava.

Whey—once considered a waste byproduct of the cheese industry—can now be used to increase the nutritive value of ice lollipops, cakes, and breads.

A new fruit drink combines grapefruit juice, strawberry puree, lemon concentrate, and sugar.

TENT NO. 3

Exhibit No. 25

Better Foods from Better Marketing Methods

Why do we have better quality food in a greater variety for a smaller proportion of our income than ever before? Partly because $10 billion is cut fom the cost of food marketing every year as a result of transportation and facilities research conducted by USDA specialists.

Faster, more efficient methods and automated handling equipment for processing, storing, and transporting food have kept pace with the dramatic improvement in the U.S. farmer's ability to produce more food. The production of broilers in Georgia and strawberries in California would be of little value to you unless the product was being delivered to your table in top condition.

More than 60 efficient food wholesaling facilities, such as the one now being developed to serve the Baltimore-Washington area, have been developed by USDA's Agricultural Research Service since 1950.

Exhibit No. 26

Guarding Fresh Produce

A hot welcome will await spoilage organisms that attack fresh produce of the future. Marketing researchers have cooked up both hot water and sauna baths to prevent spoilage without changing the taste, appearance or overall quality of fresh fruits and vegetables. Hot baths do not leave the residues that sometimes occur when chemicals are used to control decay. Although not all products can be heat-treated, good results are being obtained with peaches, peppers, and berries.

Exhibit No. 27

Longer Market Life for Perishables

Tomorrow's consumer may eat garden-fresh fruits and vegtables that have just awakened from a long cold sleep. To help lock in the freshness of some produce—and cut flowers, too—marketing researchers are replacing oxygen in the refrigeration unit with nitrogen or CO_2 gas. In this controlled atmosphere, produce in the future may "sleep" through transport and storage in dealers' storerooms, so that it reaches retail markets in the best possible condition. Apples now are often handled this way. Scientists are testing the technique with citrus, peaches, tomatoes, lettuce, roses, daffodils, and other perishables to give them a longer market life.

Exhibit No. 28

Protect Your Pets From Rabies

Rabies continues to be a growing national problem. More than 30,000 people receive anti-rabies treatment each year, primarily for bites by dogs and cats. Pets face a growing hazard of being exposed to the disease through attacks by rabid wildlife. Rabies in wild animals is increasing, especially among skunks, foxes, and bats. In 1966 these three animal species accounted for more than 70 percent of all reported cases of animal rabies.

One effective way of reducing the threat of this highly fatal virus disease is through regu-

lar pet vaccination with USDA-approved rabies vaccines. The Department's Veterinary Biologics Divison assures that only safe and effective rabies vaccines for animals are placed on the market. This is done through a continuing program of licensing manufacturers' and inspection of manufacturing procedures and vaccines.

Exhibit No. 29

The Scientist—A Vital Member of the Consumer Marketing Team

The wholesomeness and quality of farm products are important to all of us—the farmer who raises them, the trader who buys and sells them, and the homemaker who uses them. USDA's Consumer and Marketing Service serves all three by enforcing laws and regulations. These laws and regulations guarantee the wholesomeness of all meat and poultry in interstate commerce; they set nationally-uniform standards of quality, for example—U.S. Choice, U.S. No. 1, or U.S. Grade A, as a guide for the farm products trade and the food buyer; and they require truthful labeling on all packages of seed in interstate and foreign commerce so that the buyer knows what kind of seed he is buying and how well it will grow.

Exhibit No. 30

Are You A Smart Consumer?

Today's consumers want to learn more about nutrition and diet, as well as how to use their money and time wisely. The Consumer and Food Economics Research Division can help them do this.

The Division studies the kind, amount, and cost of foods consumed by different population groups and the way families use their money and other resources. It makes recommendations on diet, food buying, and selecting and using other consumer goods and services. Results of research are made available to teachers, Extension workers, and other leaders concerned with helping the consumer.

Consumer guidance materials are prepared on nutrition and food buying, clothing and household textiles, family financial planning, and various other aspects of home management and family living.

Exhibit No. 31

Why Are People Fat or Thin?

Scientists in USDA's human nutrition research use rats to get nutrition information that can be related to people. Current studies examine the roles played by heredity, diet, and exercise in body composition and relate such factors as body weight to activity and behavior.

The scientists study man's nutritional needs and the way these needs can best be met by food. Knowledge gained through research is used to influence food habits and improve attitudes about nutrition in general. With the increase in population, the need to use food more economically and in proportions that best meet individual needs becomes especially important.

Exhibit No. 32

Keeping Pesticides Safe and Effective

Federal law requires that all pesticide products be registered with the U. S. Department of Agriculture before they are marketed interstate. Before registration is accepted the manufacturer must provide scientific evidence that the product is both safe and effective when used as directed. Authority for this consumer-user protection is provided by the Federal Insecticide, Fungicide, and Rodenticide Act.

The exhibit demonstrates the variety of more than 60,000 registered products. Equip-

ment used by inspectors while collecting samples is displayed on the counter top. Collection and laboratory testing of samples contribute to an active enforcement program designed to make sure that pesticide products continue to meet high standards required for registration.

Exhibit No. 33

Plant Damage—Early Warning of Air Pollution

Vegetation injury is the most sensitive living measure of air pollution. Each pollutant produces its own pattern of leaf injury.

Research by ARS scientists at Beltsville, Md., and Cincinnati, Ohio, has identified several plants as air pollution sensors. These plants are now being used by the U. S. Public Health Service to measure air pollution countrywide.

Research now seeks answers to these questions:

How do air pollutants—in photochemical smog and from other sources—act on and affect various plants?

How do environmental factors affect plant responses to polluted air?

Can research further identify or develop resistant plants that will grow well in polluted areas . . . or otherwise control plant damage?

Exhibit No. 34

Stopping Sediment

Stopping sediment means controlling erosion. Each year, more than 3 billion tons of erosion-produced sediment is dumped into our rivers, streams, and reservoirs and onto farms and urban land.

Why is it important that this be stopped? To begin with, erosion destroys thousands of tons of fertile topsoil each year. In cities and suburbs, erosion and sediment ruins land around buildings and homes, making large areas uninhabitable. We can ill afford these losses in this age of limited food supply and expanding population.

Sediment increases the cost of making water safe for domestic use, kills billions of fish each year, fills recreational water enclosures, and makes many waterways impassable.

Erosion and sedimentation, at their present rates, literally threaten our existence. Evidence exists that the decline of more than one ancient civilization was due largely to erosion and the resultant loss of ability to produce food and fiber.

New and improved soil and water management systems will bring erosion and sediment under control. Agricultural research scientists are working diligently to devise and perfect these systems.

Exhibit No. 35

Protecting Our Soil, Crops, and Water From Pesticide Residues

Agricultural Research Service is participating in a nationwide monitoring program to determine the level of pesticides in soil, crops, and runoff water. Plans for this work call for collecting soil samples from 10,000 cropland and 5,000 non-cropland areas during the next four years. Crop samples will be taken when available, and samples of water and sediment will be collected at selected locations. All samples are taken to a central processing laboratory where scientists use ultrasensitive equipment to detect the slightest trace of pesticide residue. This scientific information enables USDA scientists to spot any build-up of pesticide residue and recommend corrective actions.

Exhibit No. 36

Aerospace Applications in Agriculture and Forestry

Photographic or electronic equipment car-

ried by satellites or planes can be used to identify vegetation and spot outbreaks of plant diseases or insects.

Remote sensing equipment aboard satellites can identify plants by spectral signature—the particular wave length in the spectrum reflected or emitted by the plants. Several ground and airborne field tests are under way to determine the characteristic spectral signature of major vegetation species. Remote sensing can provide a means for identifying the world's agricultural resources and, indirectly, help underdeveloped countries develop their natural resources and increase food production.

An infestation of the brown soft scale insect in a citrus orchard has already been accurately spotted by aerial infrared photography. This small sucking insect of citrus causes foliage to become heavily coated with a sooty mold. When aerial photographs are taken with infrared color film, healthy trees show high reflectance; infected trees reflect less light and appear darker.

science and IMPROVING OUR ENVIRONMENT

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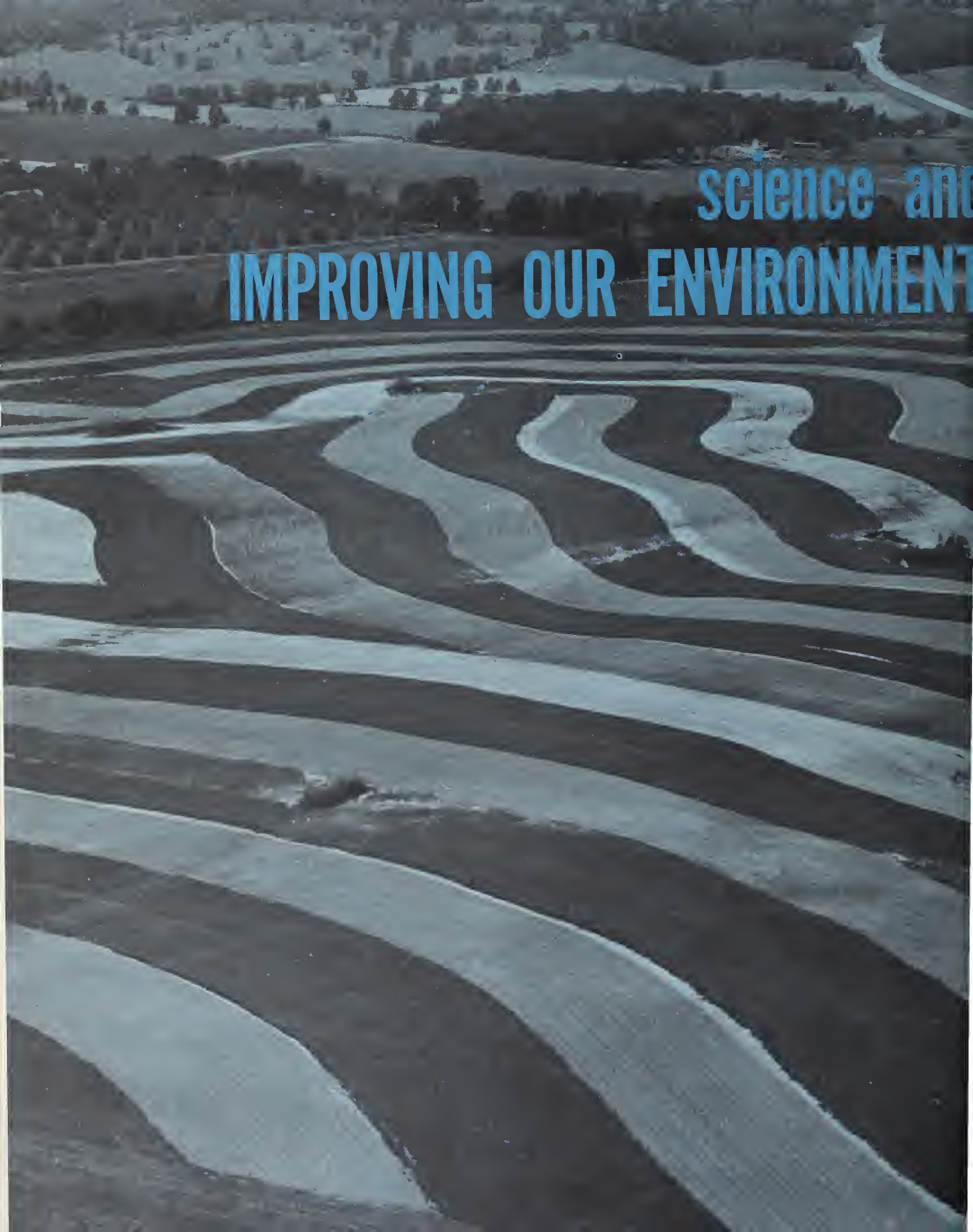

HOW AGRICULTURAL RESEARCH PREVENTS POLLUTION

Pollution. This is one of America's toughest problems.

The air in our cities smarts our eyes, chokes our lungs.

The water in many of our streams and rivers swirls a muddy brown. It is often unfit to drink, dangerous to swim in.

But, fortunately, most pollution is a man-made problem, a byproduct of our civilization. And if man can "make" a problem, he can usually solve it.

Agricultural scientists are actively fighting pollution to safeguard our good health. They are protecting the food we eat, the water we drink, and the air we breathe. Here are a few cases in point, both past and present:

- Agricultural scientists helped stop duststorms that once drove farmers from the land and that coated and choked our cities. Now only prolonged, severe droughts cause dust that is remindful of the 1930s.
- They designed systems of strip cropping and terracing to hold soil on hillsides and reduce silt in our water.
- They are finding new methods of using farm wastes: feathers in feed and dehydrated manure for garden plots. As usable products, these wastes are thus canceled out as potential pollutants.
- Agricultural scientists are tricking insect pests into destroying themselves. By so doing, they reduce the need for farm pesticides, still another source of pollution.

Silt . . . dust . . . farm wastes . . . pesticide residues . . . all can be troublesome pollutants against which agricultural scientists continue to work. Knowledge gained is being applied on the farm. Quite often it has a place on urban land too.

Pesticide monitoring teams collect water from lakes, streams, wells and cisterns. Samples are then analyzed for pesticide residue. Teams also sample soil, silt, crops, livestock, insects, and species of water and land animals.

problem: SILTING OF RIVERS

Let's look briefly at the problem of silt, which some experts say is the biggest—and oldest—source of water pollution. Indeed, archeologists say silting and flooding caused the downfall of some of the world's oldest civilizations.

Today, on your way to work, you may pass construction sites. Great earth-hungry machines are scalping grass cover off large tracts—more than a million or more such U.S. acres each year—for roads, airports, shopping centers, and homes. These machines represent progress in your community. But as they peel back acre after acre of grass, they expose bare soil to the erosive force of rain. A heavy downpour, and tons of soil wash into our rivers.

The Anacostia River in Maryland is a graphic example. There, silting only recently was so severe that a dredge boat used upstream had to do additional dredging to get back downstream. Sediment washed down from suburban construction sites in the watershed had closed the channel during the time the boat worked upstream.

As taxpayers, we either pay for dredging, or we suffer the consequences: Flooding of our homes, businesses, and industries.

As a taxpayer, you ask, isn't there a cheaper way? The answer is yes. By preventing the erosion in the first place. By covering construction slopes with an inexpensive mulch. By building grassed waterways or leaving waterways unscalped.

Research has established the means of preventing erosion and silting: Terracing, strip cropping, waterways, mulching, and plowing and planting around slopes instead of up and down them. These measures work. That's why American farmers have established more than 1,225,000 miles of terracing, 20,000,000 acres of strip cropping, and 1,700,000 acres of grassed waterways on U.S. farms.

These are conservation practices that slow water down, cause it to soak into the soil, or divert it safely into ponds or reservoirs. They reduce flooding, and they make more water—clear water—available to you and to business and industry.

Research serves as the foundation for this Nation's broad soil and water conservation program—a foundation that is constantly being examined. At times, questions asked by agricultural scientists are very basic:

- How do soil particles move through water? New knowledge is needed in the design of improved stream channels.
- What effects do raindrops have on soil surface? Added facts could lead to soil management that permits more water to soak into soil.
- How does moisture move through soil? A better understanding might open the way to more efficient plant use of soil moisture.

Questions often relate directly to a problem. How, for example, can we prevent erosion of streambanks and roadside embankments? The answers led to two measures that protect and re-create:

Cotton netting impregnated with a herbicide (weed killer) can be cut to fit planters and small garden plots. The netting, still in the test stage, disintegrates in one season. Its advantage: Soil can be treated with precise, minute amounts of herbicide.

(1) Flat cellular blocks, looking like oversized waffles, greatly enhance the appearance of streambanks and lake frontages for swimming and boating. But, even more important, they stop erosion and the resulting siltation that pollutes waterways. Eventually, their production may add industrial jobs to our communities.

(2) Flowering ornamentals—daylilies, iris, yellow jasmine, English ivy, periwinkle, honeysuckle . . . For yards and gardens? Not exclusively. They can also be used on highway cuts, fills, and ditches. Their flowers and foliage beautify our environment; their roots hold soil in place and keep it out of our streams and lakes.

The reverse of heavy rains, and flooding, is drought and wind erosion. But farmers now know how to keep their soil from blowing.

Research has given them drought-resistant cover crops and such effective conservation practices as strip cropping, deep plowing, and cloddy fallow. Research showed them how to make shelterbelts to slow the wind, taught them to cultivate their fields without destroying the stubble from past harvests. Research has also given them better ways of controlling grasshoppers—insects that once destroyed the grass cover.

Some of these dryland farming techniques and materials—time and rate of seeding and drought resistant grasses—also help householders establish lawn grasses.

Homeowners know, from sad experience, that failure of grass seedlings to emerge is due to lack of moisture. Dryland farmers know this, too.

To help assure germination and growth, crop scientists selected strains of intermediate wheatgrass that can penetrate the soil surface from greater depths. Now it is possible to seed the wheatgrass deeper—in moist soil, the seedling will emerge and grow, and its roots will bind soil particles against the wind. The same could be true with lawn grasses.

Cellular blocks protect a stream bank against erosion; they also stop silting, a major source of water pollution. Once the blocks are installed, the cellular openings are seeded to grass. Roots then lock the blocks in place against the rush of water.

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problem: FARM WASTE

In addition to seeking ways to prevent pollution of the air and water by soil, agriculture also must protect the environment against wastes—both from agricultural processing plants and from farms. Although much remains to be done, progress can be cited.

For example, those coffee grounds you put down the drain most likely are treated by aeration at your municipal disposal plant. Aeration disposal (the breaking down of readily oxidizable wastes by bacteria) was adapted by agricultural scientists to treat waste water from dairy plants at a very high rate. This same concept now is being used to treat many types of industrial wastes—municipal, canning, cosmetic, citrus, even textile and petroleum.

As this Nation's population approaches the 200 million mark, waste disposal becomes an increasingly greater challenge. Frequent municipal bond proposals to raise money for expanded sewage systems and disposal plants remind us of this. So do trashy highways—with literally tons of refuse per mile.

Consider also the tons of trash that are dumped illegally upon farmland. How is a farmer to get rid of a trailer load of tin cans, a tattered mattress, a spent water heater, and chunks of broken concrete and bricks? He has enough worry disposing of farm wastes.

Livestock are now producing more than 2 billion tons of manure each year. Farmers have put this waste to work by spreading it on their fields as fertilizer. But around cities, manure spreading often isn't the answer.

Today, many large feeding operations, originally in rural areas, have been encircled by metropolitan "sprawl." Objectionable odors and polluted runoff water limit the use of adjoining land either for housing or recreation. And since these producers of livestock have neither adequate pasture or cropland, they cannot use manure for fertilizer on their fields.

A few of these large producers dehydrate manure, bag it, and sell it to home gardeners and commercial growers. Some others build shallow ponds, called lagoons, for manure disposal. Too often, however, the lagoon discharges fertilizer nutrients into rivers, lakes, and streams. There it nurtures the growth of algae, other aquatic weeds, and slimes.

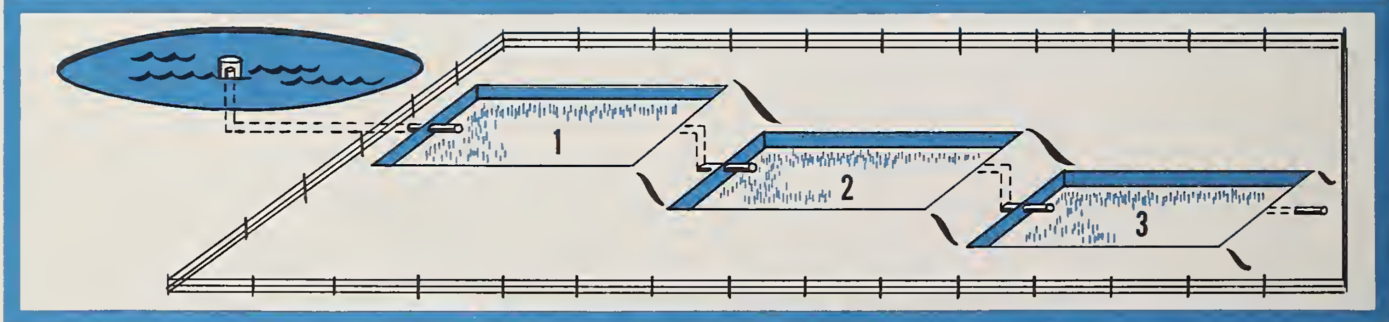
The result: We have undesirable recreational waters and poor fishing.

Agricultural engineers propose **using** the fertilizer elements from manure lagoons. A series of basins, planted to grass, would serve as mechanical and chemical filters that purify the runoff water from the lagoons. As a bonus, the basins yield forage that can be fed to livestock.

Research is also finding ways to **use** other wastes—from agricultural processing plants, for instance. Feathers go into feed; so do dried citrus molasses and numerous other wastes of fruits, vegetables, and field crops.

The 9 pounds of watery whey left over for every pound of cottage cheese made was a serious river pollutant. Now, as a result of science in agriculture, the whey can be dried into a nutritious product useful in making cookies, sherbets, puddings, and ice lollipops. It also is mixed into animal feeds. Or it can be converted to yeast.

A hydroponic system is being tested on a Maryland dairy farm to dispose of milking parlor wastes. The wastes flow from a manure lagoon (shallow pond, left) into hydroponic basins (1, 2, and 3). The basins, planted to grass, purify the runoff water from the lagoon.



Entomologists have discovered a substance that stimulates feeding by houseflies. Coupled with an insecticide, the stimulant could become a selective method of controlling this pest.

problem: CHEMICALS

Americans enjoy the most abundant and wholesome food supply in the history of mankind. One major reason for this is pesticides, a large and varied group of chemicals used to kill such pests as insects, weeds, and fungi. These pests would otherwise destroy or greatly damage our food crops.

The job of controlling these pests is a big one; but, considering our agricultural output, it is being done with relatively small amounts of chemicals.

Even less will be needed in the future: For example, scientists have found that some crop pests can be protected from insects with as little as 2 ounces of an undiluted pesticide per acre. They are also developing selective chemicals, those that single out one insect or one weed—and do not harm friendly insects or crops.

Less than 5 percent of this Nation's land is now treated with pesticides each year. And our scientists constantly guard this land. They monitor soils, water, crops, livestock, beneficial insects and aquatic land animals in areas of both heavy and light pesticide uses.

These activities are part of a Government-wide effort coordinated through the Federal Committee for Pest Control. They include monitoring by the Departments of Agriculture, Defense, Interior, and Health, Education, and Welfare.

HEW's Food and Drug Administration, for example, makes "market basket" studies, in which it collects and analyzes food samples from grocery stores. This, of course, is done to see if there are any pesticide residues—or any unsafe levels of residues—in foods we buy. The studies have shown that pesticide residues rarely are present in food. When they **are** present, levels are less than 1 percent of the safe legal tolerance.

USDA's Agricultural Research Service studies samples of soil, water, crops, animals, and insects as a safeguard against over use of pesticides. More than 3,000 samples are analyzed each year from the Mississippi Delta alone. Even though this area has a long history of heavy pesticide use, preliminary results do not show any progressive buildup of organic pesticide residues in soil, sediment, and water.

The Department also monitors soils at 55 test sites throughout the Nation, as well as areas treated in Federal-State campaigns against major insect and weed pests.

But most important—where levels of pesticide residues are found to be higher than legally permissible, corrective measures can be taken quickly.

Because they are hazardous substances, pesticides must be registered with the U.S. Department of Agriculture if they are to be marketed in interstate commerce. This means that each pesticide must do what the label says it will do—and be safe when used as directed on the label—before it can be registered.

USDA inspectors regularly check pesticide products in retail stores. They make sure these products continue to satisfy registration requirements.

Thus, when pesticides are used properly, as the label directs, this registration-labeling process guards against injury to man and animals—and prevents pollution of the environment.

Research is being conducted, nevertheless, over a broad front to find new methods of controlling insects—methods that will reduce the use of chemical insecticides or lower the amounts necessary.

Scientists for many years have, for example, been developing new crop and ornamental varieties—now at a rate of about 80 per year. Many of these have built-in insect and disease resistance. A new corn, for example, resists larvae of the western corn rootworm, one of the most destructive insects attacking corn in the Midwest. And a new snap bean variety has good resistance to curly top disease.

But because new strains of insects and diseases appear, the never-ending search for resistant crops goes on.

The search for other nonchemical methods of control also continues—in some rather unusual directions. Some of these include—natural enemies of pests that attack crops; sterilization of insects by radiation; and a type of "death ray" for use against pests of stored grain.

If you live in the northeast, you may know that a bacterium causing "milky spore disease" has been used widely there for years to control the costly Japanese beetle.

More recently, scientists found a bacterium very effective against certain caterpillars that attack vegetables, cotton, and tobacco. This "natural insecticide" now is being recommended for use by farmers.

Just as with pesticides, microorganisms must be proved safe, as well as effective, before they can be registered for use.

Insect "explorers" continue to comb the world for additional parasites that will help control insects and weeds in this country. They are also spreading those already known here into new areas.

Four species of parasitic wasps that attack the alfalfa weevil have been introduced and are now established and spreading in new locations. In addition, there are fly larvae that destroy the seeds of a troublesome weed; wasps that kill the citrus blackfly in Mexico and prevent its entry into the United States; and a fly that parasitizes the European corn borer, one of the costliest of all U.S. insect pests.

Once established, these and other friendly insects continue to work, continue to eliminate the risk of pollution—at no additional cost to producers. Resulting dollars saved can be passed along to you in the form of lowered food costs.

Natural enemies of insect pests—virus and bacteria, for example—are proving effective alternates to chemical insecticides. But before they can be approved for use against an insect enemy, many tests must be run. Here, a microbiologist prepares a diet for honeybees containing an insect pathogen.

Perhaps the most successful new biological control method—male insect sterilization—illustrates yet another way scientists are eliminating pests without chemicals and without the danger of pollution. Using atomic radiation to sterilize insects, agricultural scientists developed a technique that ultimately eradicated a costly livestock pest—screwworm flies—from the United States. This sterilization technique represents an effective peacetime use of atomic energy.

Insect sterilization is now being tested against the boll weevil—an insect whose control takes almost a third of the insecticides used each year in the United States. It is also being tested against the codling moth, the historic worm in the apple; against the omniverous leaf roller, which attacks more than 40 species of plants; and against the corn borer.

In each case, pesticides used to control these pests would largely be eliminated as a possible source of environmental pollution.

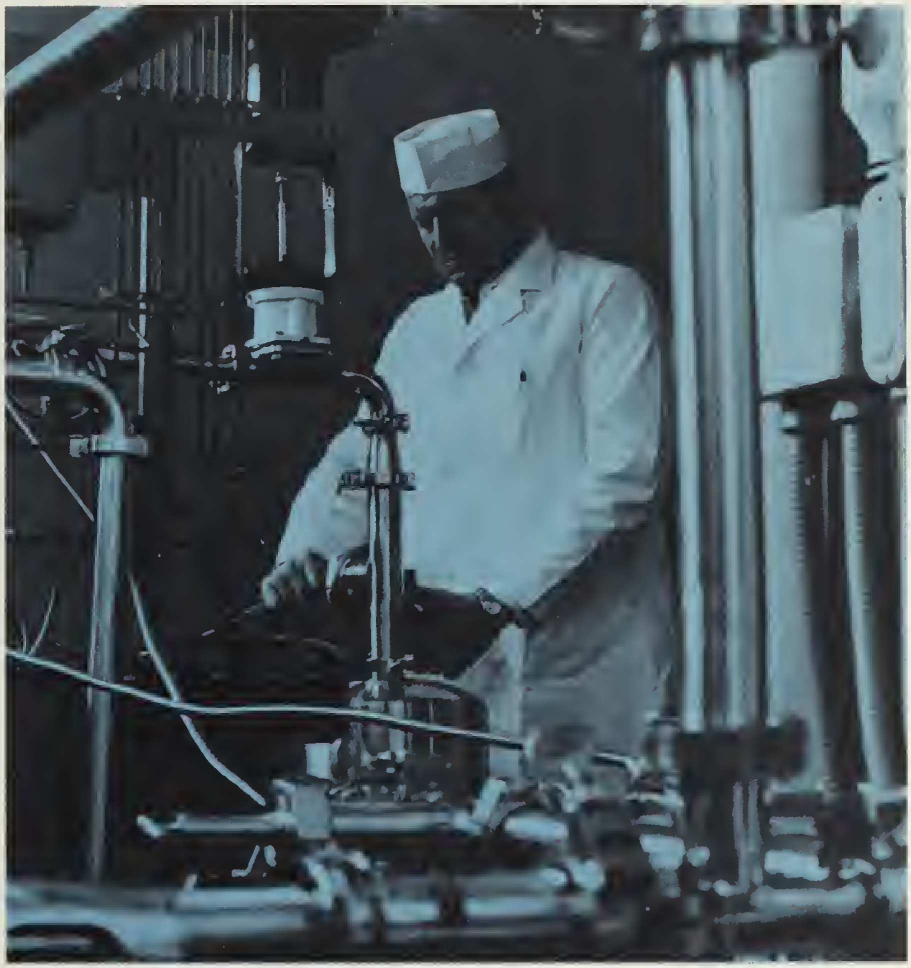
Like progress can be cited in combatting insects of stored food and feed. Approaches now being tested could one day replace fumigation. (See photo below)

Even considering these remarkable new developments, however, agricultural chemicals remain a necessity in modern agriculture. The aim is to reduce the necessary amount of chemicals and make sure they are used wisely—and safely.

Scientists are studying radio frequency as a possible alternate to fumigation to control insects in stored grain. Although more costly than fumigation, the treatment has proved effective against seven insects often found in wheat, rice, corn, and flour.

Scientists are developing a way to remove radioactive strontium 90 from milk—should the need arise. The system could be installed in milk plants and be operated continuously as an integrated part of the processing equipment.

problem: IF FALLOUT OCCURS



Although research in protecting the environment primarily is concerned with problems facing us today, it also looks to the future.

Soil scientists are seeking ways to protect crops, and indirectly man and animals, from radioactive fallout—should this emergency ever arise. They found that they can eliminate the uptake of radioactive strontium by soybeans and grain sorghum. The process is costly; but in a crisis, it could be a bargain at twice the price. The process involves covering the strontium with a layer of root-inhibiting sodium carbonate and burying it under 20 inches of soil.

Our scientists have also developed an emergency standby process for washing strontium 90 off wheat. And they have designed equipment that can remove more than 90 percent of radioactive strontium from milk.

But whether the threat to our environment is potential or at hand, the job ahead is a big one. It becomes much bigger when we consider nonfarm sources of pollution: automotive exhausts, rubber from tire wear, mine drainage, detergents, industrial smoke and other waste, and silt from building sites.

The challenge must be faced by everyone in our nation. Science in agriculture is giving a high priority to eliminating every major farm pollutant—particularly those that affect our health.

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science and america's beauty

U.S. DEPARTMENT OF AGRICULTURE Agriculture Information Bulletin No. 323

science and america's beauty

When you add beauty to your surroundings by planting trees or shrubs, you have help in your work: Science works with you.

Plant explorers and *breeders* help you by providing better ornamental plants. *Horticulturists* and *physiologists* help you by making plants easier to grow successfully. *Quarantine inspectors, entomologists,* and *pathologists* help you by protecting your plants against destructive pests.

better plants . . .

For 70 years, plant explorers of the U.S. Department of Agriculture have ranged over the whole world searching for plants useful to our country. Among the many ornamental plants they have found for America—and for your yard—are the famous Japanese cherry trees, zoysia lawngrass, and scores of rhododendrons and azaleas.

What may be one of our best ornamental trees came to us as a result of a destructive disease of fruit trees, fire blight.

In the early days of this century, outbreaks of fire blight wiped out pear orchards in the San Joaquin Valley and southern California and threatened the pear-growing industry in the Sacramento Valley. One way to conquer the disease: Find a tree resistant to fire blight and pass its resistance on to orchard trees through a breeding program.

Frank Nicholas Meyer, USDA's pioneering plant explorer, found in China a wild pear tree that was resistant to fire blight. He collected seeds of the wild pear and sent them back to the United States. The seeds were grown into trees to furnish, through their pollen, the gene for fire blight resistance. And for many years this was the tree's main value—as a source of pollen.

Many of our best decorative plants have been found in odd corners of the world by USDA plant explorers.

Then times changed. Agricultural research helped to increase the productivity of American farms more than fourfold, to reduce the labor needed for survival, to give us time to enjoy our lives. And with this change in times came a change in outlook.

At the Plant Introduction Station at Glenn Dale, Md., a researcher looked at one of the Chinese wild pear trees and saw not only a source of blight resistance but also a potentially valuable ornamental tree.

He saw a tree that bloomed abundantly in early spring, grew with upswept branches, had foliage that turned color brilliantly in fall. It showed promise of being an excellent street tree.

The wild pear was propagated and tested under conditions which challenged its ability to grow as a street tree. More than 100 trees were set out along the curbing in University Park, Md. They were watched closely to see how well they would withstand heat reflected from paving, to see if they could survive in the fumes of a suburban automobile culture.

The pear tree passed all its tests. It was then released to nurserymen for propagation and sale as 'Bradford Pear.'

Frank Meyer's wild pear tree may yet help us conquer fire blight—the disease is still with us, kept under control by sprays and dusts. But meanwhile you have an excellent ornamental tree for your street and your yard.

One of the chief aims of plant improvement—breeding as well as exploration—is to extend the geographic range of ornamentals.

Bradford Pear, brought from China for fruit breeding, may be one of our best decorative trees for street plantings.

• A plant explorer, looking for coldhardy plants, collected seeds of a privet from the dry, barren hills near Sarajevo, Yugoslavia. After being tested in this country, the privet was named 'Cheyenne' and was released for use in the northern prairie and eastern Great Plains States—an area where few other hedge plants are sufficiently coldhardy and drought tolerant to survive.

• USDA scientists at Cheyenne, Wyo., have developed carnations and chrysanthemums that survive the biting cold of our western mountain States.

• Breeders at USDA's National Arboretum are developing hardier crapemyrtles. Through much of the South, these shrubs add brilliant color to yards and parks during midsummer and into fall when few other ornamentals are in bloom. Now the researchers hope to extend this summer color to many more gardens, northward and westward. As a result of their work they have released the hardier crapemyrtles 'Catawba,' 'Conestoga,' 'Potomac,' and 'Powhatan.'

Breeders also are trying to improve the appearance of ornamentals we now have in our gardens. A plant breeder at the National Arboretum, for example, is trying to add together the good features of a number of hollies to produce better hollies: Plants with glossy spined leaves and red berries, plants that hopefully are hardy in the North yet tolerant of heat and drought and able to grow in alkaline soils.

The breeder is helped in his program by the vast collection of hollies maintained at

Vast collections of plants at the National Arboretum furnish plant breeders with a pool of characteristics they can use in custom breeding new kinds of ornamentals.

the National Arboretum—a pool of holly characteristics he can use in custom breeding new kinds of hollies.

Ornamentals researchers sometimes help to improve plants for our gardens just by keeping their eyes open. While a horticulturist at the Arboretum was looking for the name tag on a large old Japanese holly plant, he noticed an odd shoot growing from the base of the plant. Leaves on the shoot were finer and grew closer together than leaves on the rest of the plant.

The horticulturist cut the top from the holly plant, allowing the odd shoot to grow by itself. It grew into a billowy, conical plant 10 feet tall and 8 feet wide. It was named 'Highlight' for the highlight-and-shadow appearance of sun on the foliage.

In addition to Bradford, Cheyenne, Highlight, and the new crapemyrtles, other new breeds are on the way for your garden:

- Tetraploid daylilies, larger than the usual daylilies, and blooming, not just one day, but for several.
- New improved native hollies, mountain-laurels, and azaleas from the Appalachians.
- A fragrant pink camellia, a cross between a white camellia that is fragrant but not showy and a pink camellia that is showy but not fragrant.

Highlight, a new selection of Japanese holly, is available because a sharp-eyed horticulturist at the National Arboretum spied an odd and attractive shoot growing from the base of an old holly plant.

easier care . . .

Remember last winter when you looked through the nursery catalog and thought of the improvement to your yard that a few more shrubs could make? Somewhere in the catalog was probably a map of the United States divided into 10 plant hardiness zones. And the descriptions of the shrubs referred you to one of the 10 zones.

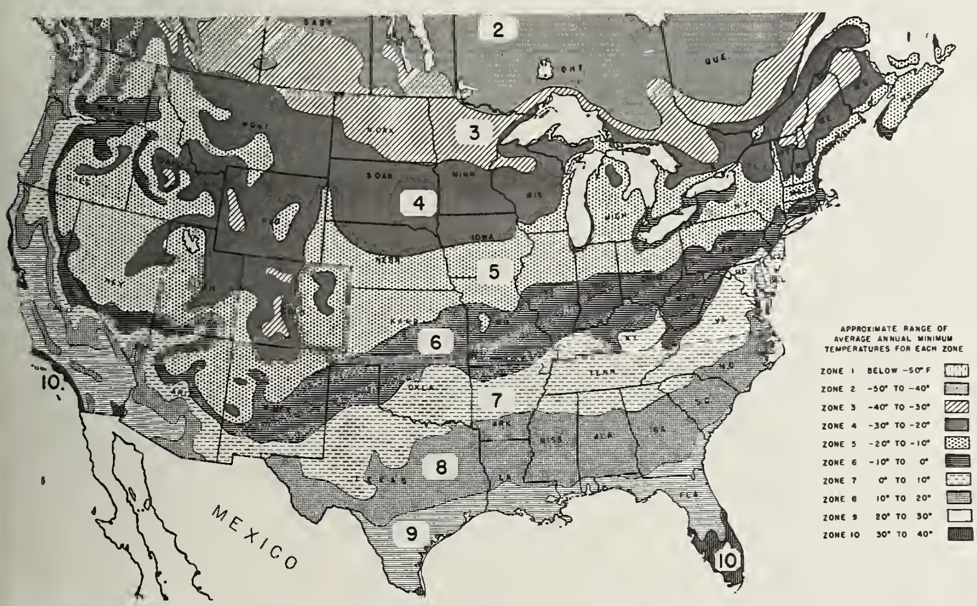
From the map and the descriptions of the shrubs, you were able to tell how far north the shrubs could be planted safely—whether they could live through the winter in your backyard without special care.

The map and the coldhardiness ratings were prepared by USDA's National Arboretum in cooperation with the American Horticultural Society.

The National Arboretum was established in Washington, D.C., ". . . for purposes of research and education concerning tree and plant life." The plant hardiness map is one of the Arboretum's "education" projects. Another is the series of demonstration plantings within the Arboretum.

Perhaps you are one of the many thousands of persons who have visited the Arboretum in April or May to see the azaleas in bloom—more than 70,000 plants displayed in appropriate groups and settings.

Or maybe you have been there to see the demonstration plantings of street trees, or the crabapples, hollies, magnolias, camellias, dogwoods, boxwoods, or the many other



Can you grow camellias in your backyard? The Plant Hardiness Map, with the aid of a nursery catalog, will tell you if you can.

groups of ornamental plants that are found in the Arboretum. And maybe these plantings helped you decide what to plant in your own yard.

Thousands of gardeners have used the plant hardiness map, and the Arboretum's demonstration plantings, to help them choose the best ornamental plants for a particular area and setting. But sometimes we can't seem to find any ornamental plant that will do the landscaping job that we want it to.

What can we do about it? Plant physiologists of ARS have found that plant germination, growth, flowering reproduction, and dormancy all depend on the color and intensity of light that falls on the plant; that these responses can be changed by changing the plant's exposure to light.

And they've found that many plant responses also can be triggered by treatment with chemicals that regulate plant growth. Plant-growth regulators can hasten rooting of vegetative cuttings; they can retard the growth of a plant; they can slow down blooming; they can even cause the plant to grow itself to death. The growth regulator that you probably are most familiar with is 2,4–D, the weed killer used on lawns.

Light management, growth regulators, and other practices developed by agricultural researchers have made gardening less expensive for you in addition to making it easier. They made it less expensive by making it easier for nurserymen, who have to charge their customers for the work they do.

Chances are you bought some ornamental plants last spring—a flowering crabapple, some rose bushes, an azalea, some evergreens, or maybe just a tray of petunia plants or a packet of zinnia seeds. If you did, you helped support an agricultural enterprise worth more than $500 million a year. And it's still growing.

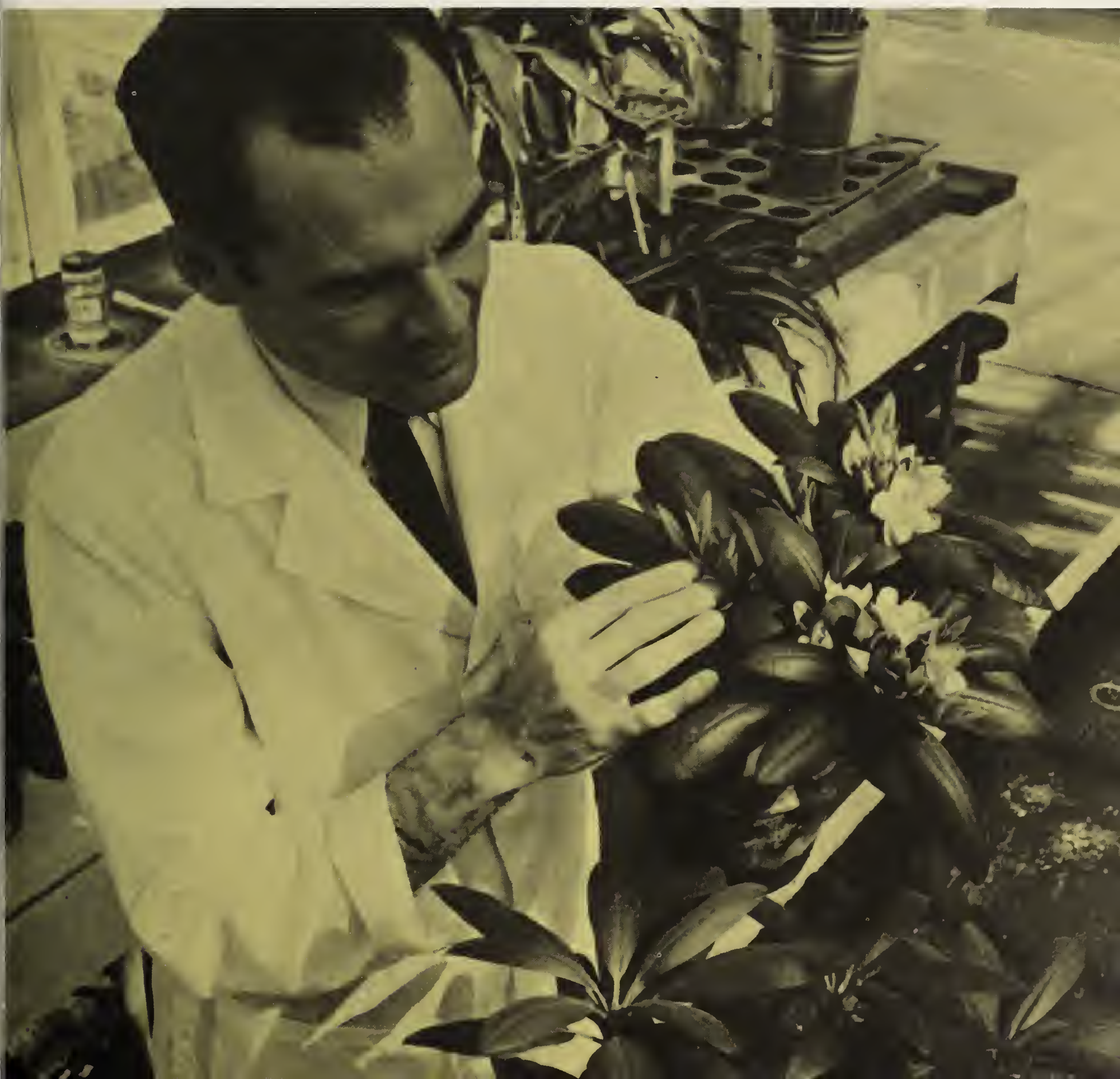
Agricultural research helps it grow by finding ways for nurserymen to meet an increasing demand for planting stock and by providing the nurserymen with labor-saving processes that make it possible to keep their prices low.

If you are like other gardeners, you want to see a flowering shrub in bloom before you buy it. In the past this has meant that several years might pass between the time a cutting of the shrub was rooted and the time it came into bloom. But by using controlled light exposure and growth regulators, physiologists have been able to hasten this blooming time. Now, for example, you can see a rhododendron in bloom the next season after it's rooted; and you don't have to pay for several years' care of the plant until it reaches blooming size.

Other ways research has found to help nurserymen produce large numbers of plants at low prices:

- Many kinds of cuttings that are normally difficult to root will root readily if they are first treated with a growth regulator.
- Losses during rooting can be kept low if cuttings are wet constantly by a fine mist.
- Many kinds of tree seedlings can be forced to put on several seasons' growth in a single year if they are lighted for part of the night during fall and winter.

After treatment with controlled light and growth regulators, a year-old rhododendron plant blooms and shows its colors to a prospective buyer—years ahead of schedule.



Another help likely to be available soon: Chemical pruning.

Many kinds of ornamental plants have to be pinched or pruned while they are growing to make them bushy. Already we have materials that you can add to the soil to make your chrysanthemums remain compact without pinching.

Suppose we had a spray that would selectively kill just the tips of the stems of plants that you spray it on, that would not harm side shoots, foliage, or stems of the plants. And suppose the material worked quickly, so you could see within 15 minutes which stem tips had been pruned. This would mean a considerable saving in hand pruning and savings in expense of raising nursery stock.

Such a material has been found. It won't be ready to market, however, until researchers have found all the answers to possible questions of safety and effectiveness of the material.

Though a chemical pruner would be most valuable to nurserymen, it also would be useful to you in your home garden. Here it would join other products that have made gardening more enjoyable by making it easier:

- Weedkillers that control broadleaf weeds in your lawn—plantain and chickweed, among others—without damaging the lawn.
- Herbicide-treated cloth used to cover soil under plants; it destroys weeds as they emerge from the soil, and you don't have to pull them by hand.
- Long-lasting and high-potency fertilizers that can keep your lawn green all season with one application; they release nutrients a little at a time, rather than all at once—and with no danger of burning your lawn.

Plant quarantine inspectors intercept foreign insects, diseases, and nematodes at ports of entry before the pests can attack your garden.

protecting plants . . .

One evidence of science's success in protecting your ornamental plants is the insects and diseases that are *not* in your garden. Protection begins far from your flower beds; it begins at the ports of entry into this country from abroad.

Plant quarantine inspectors keep watch at ports of entry for foreign insects, diseases, and nematodes and for products that may harbor these pests. They are successful, too. On an average of once every 16 minutes around the clock each year, inspectors intercept a potentially dangerous pest—a pest that does not make it to your yard.

State and Federal quarantines within this country also help keep your yard free of pests. If, for example, you are among the fortunate minority of the country's gardeners who do not now have to worry about Japanese beetle, quarantines are helping to insure that you won't become troubled by it.

Before plant material can be shipped to your home from an area infested with Japanese beetle, the shipper must comply with regulations ensuring that no live beetle eggs, grubs, or adults will be shipped with it. Thus far, quarantine has kept the beetle out of the West.

A come-hither odor lures male gypsy moths to a trap. If we can do away with most of the males, we should be able to wipe out a troublesome pest.

If you are among the unfortunate gardeners who have to combat Japanese beetle, you may be using milky spore disease—developed as a beetle control by agricultural research—to reduce the damage to your garden. This disease kills larvae of the beetle in the ground. And you know that milky spore has several drawbacks: It's expensive to use ($24 an acre) and just about everyone in a community has to apply it to his property for the control to be effective.

Agricultural research is doing something about these drawbacks.

Scientists at USDA's Northern Utilization Laboratory, Peoria, Ill., now are searching for a way to mass produce milky spore material at low cost. These researchers are specialists at producing biological materials by using industrial fermentation processes. They are the scientists who developed the process for mass producing the lifesaving drug penicillin. With their success in manufacturing a cheap milky spore material, the Japanese beetle should be eliminated as a threat to every eastern rose garden.

Milky spore is effective against Japanese beetle, yet harmless to all other forms of life. Entomologists are looking for ways to control other destructive insects without harming beneficial or "innocent" organisms.

One possibility: Use of a sex lure and a chemosterilant. The sex lure attracts male adults of the destructive insect; the chemosterilant makes them reproductively sterile.

If the sex lure is successful, most of the males of an insect population are sterilized. Females that mate with sterile males produce infertile eggs, and the destructive population is reduced, finally destroyed.

Plant pathologists also are looking for preventives or cures for plant diseases. They have been able to turn black spot of roses from a major destructive disease to a minor annoyance. And breeding programs now underway may develop garden roses that are entirely free of black spot, as well as other rose diseases.

But pathologists have not always been successful. Dutch elm disease, for example, has defied control. It may finally fall, however, before a combination of better fungicides to protect against infection and better insecticides to kill insect carriers of the disease. And then you'll once again be able to shade your home with American elm trees.

Black spot, a destructive disease, attacks garden roses but not hedge roses. Scientists have learned how to cross the two kinds of roses. Their hope: A garden rose that is resistant to black spot.

tomorrow . . .

Tomorrow's developments in ornamentals research probably will be aimed principally at solving problems—problems such as smog; problems such as a nightless environment in brightly lighted gardens and shopping centers; problems such as recurrent droughts, with no water to spare for ornamentals; problems such as a demand for planting stock that far exceeds our present capacity to produce.

And Researchers will solve the problems:

- Breeders will come up with new varieties of ornamentals that are smog resistant and drought tolerant.
- Physiologists will find growth regulators that will make brightly lighted plants go dormant in winter, rather than remain active and be killed by cold.
- Horticulturists will find ways of quickly increasing production of our best ornamental plants.

Tomorrow agricultural research also will be aimed at convenience:

- Growth retardant sprays that limit growth of lawn grasses, so you need cut the lawn just once a season.
- Better, safer, easier, more selective control of weeds.
- Systematic insecticides that keep your plants free of insects all season with just one application.
- Rapid-growing trees and shrubs that quickly beautify newly built homes.

Plant explorers, plant breeders, plant physiologists, plant pathologists, entomologists, quarantine inspectors—all are agricultural scientists using their green magic to bring us better ornamental plants and better ways of gardening. Scientists working together to bring American gardeners many pleasant hours of recreation and . . . Tomorrow . . . a more beautiful America.

information

Agricultural research helps in America's beautification by making public the results of its work. You can help to assure America's beautification by making use of this information.

The following publications contain information that may be useful to you in beautifying and maintaining your home grounds. The publications are available, at the indicated price, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Please include your ZIP Code when ordering.

Title	Price
G25, Roses for the Home	$0.15
G51, Better Lawns	.15
G53, Lawn Insects: How To Control Them	.15
G61, Lawn Diseases	.15
G65, Growing Chrysanthemums in the Home Garden	.05
G66, Growing Iris in the Home Garden	.05
G71, Growing Azaleas and Rhododendrons	.05
G76, Growing Ornamental Bamboo	.05
G79, Controlling Lawn Weeds With Herbicides	.10
G80, Home Propagation of Ornamental Trees and Shrubs	.10
G81, Maple Diseases and Their Control	.05
G83, Pruning Shade Trees and Repairing Their Injuries	.10
G86, Growing Camellias	.10
G88, Growing the Flowering Dogwood	.05
G89, Selecting Fertilizers for Lawns and Gardens	.05
G91, Growing Flowering Annuals	.10
G95, Reducing Salt Injury to Ornamental Shrubs in the West	.10
G102, Iron Deficiency in Plants: How To Control It in Yards and Gardens	.15
G104, Protecting Shade Trees During Home Construction	.05
G114, Growing Flowering Perennials	.10
G117, Trees for Shade and Beauty	.10
G120, Growing Boxwoods	.10
G126, Growing Peonies	.10
G130, Growing Hollies	.10
G135, Growing Flowering Crabapples	.10
G136, Spring Flowering Bulbs	.10
PA791, Color It Green With Trees	.20
AB237, Controlling Insects on Flowers	.40

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science and SAVING WATER and SOIL

AGRICULTURE INFORMATION BULLETIN NO. 324 U.S. DEPARTMENT OF AGRICULTURE

science and SAVING WATER and SOIL

When you bought that pleasant little house, in that pleasant little suburb near the big city, you bought some unpleasant little headaches. Mud washes across your lawn from the house going up next door or from the new apartment up the block. Your new lawn dries and cracks. That trough where the grass won't grow becomes a gully. Your street is covered with mud. Your children wade in a dirty stream.

The trouble is water. Too much or not enough. Too soon or too late. Or in the wrong place.

More Water and No Water

Men have worked a long time to solve their water troubles. And they've found some answers.

Most of the answers have been of desperation. Let's say you live Front Street in Marietta, Ohio. Or the river in Parkersburg, or Cincin or Covington, or Cairo. Every spri well, almost every spring—when w snows melted off the hills that had stripped of their trees, you had trouble. After the flood, your m scraped upriver dirt off her living- rug and lighted the base burner a Your father took down the boards a his store front, shoveled out the and moved the cans and hardware from the upstairs room onto the she

But, now those every-spring water marks have faded away in th hometown. We, you and your go ment, have learned how to slow the down, with dams on the Little Miam Monongahela, the Muskingum,

That trough where the grass won't grow becomes a gully.

Wind blew the winter-bare soil, each year blowing more than the year before—and left dust drifted ankle to knee deep.

others. We have learned how to keep it out of your house on Front Street with levees and deep channels. With terraces and waterways, stripcropping and better land use. And with tree-covered slopes. But we have not learned how to keep the river sparkling clean—not yet. This will come soon, we hope.

Remember the thirties? Maybe you lived in Colorado then, and you were driving north on U.S. 287 from Springfield to Lamar when the "black blizzard" hit. The dust blacked out the sun, the road, every landmark. You rolled up the windows tight and pulled over to what you hoped was the side of the road, praying that your car wouldn't be buried, like those houses in Pompeii. This too, was water trouble. In the years of good prices after World War I, the grasslands of the Great Plains were plowed and planted—and wind blew the winter-bare soil, each year blowing more than the year before. The long, dry summers of the early thirties left dust drifted ankle to knee deep.

We, you and your government, found the answers to that trouble too—ways to nail the soil down again. Scientists of the U.S. Department of Agriculture helped our farmers reclaim the dustbowl. Together, they planted shelterbelts—long rows of trees that slowed down the winds. They found new crop varieties that covered the soil for a longer time or grew well in dry weather. They worked out better ways to farm these dry lands. And they made soil surveys that told each farmer what kind of soil he had, so that he could choose the crops that would grow best on his farm.

Today, the old dustbowl is tamed. But we must watch it closely, to keep it that way.

Trouble begins when bulldozers strip the cover from millions of acres.

Silt . . . into ponds and reservoirs, filling them up. Delta in foreground was formed by silt from Missisquoi watershed in Vermont.

And Sliding Soil

Now, we have another kind of water trouble. Some of our fast-growing cities have this trouble so regularly that new businesses have sprung up to take care of it. In suburban Los Angeles, for example, level land is scarce and new housing projects are filling steep-walled canyons. You can telephone for help when a sudden shower brings down the uneasy backyard above you. For a fee, a fast-moving crew will shovel and scrub your home back into shape. This, though, is the answer for only a few.

Trouble begins when bulldozers strip the cover from millions of acres. They clear land for new highways, shopping centers, and housing developments. Rain tears away the unprotected soil and carries it into streams and rivers, clogging them up. Into ponds and reservoirs, filling them up.

Scientists who struggle with water trouble say more than a billion cubic yards of water-carried dirt settles into our reservoirs each year. It displaces enough water to satisfy the daily thirst of 5 million men and women. We must save this water, and save this soil. Keep it off your lawn, out of your house, out of your rivers. Keep soil from moving.

The best way to stop this moving soil is to cover it quickly with plants. Scientists of the Agricultural Research Service are trying out many kinds of plants to find the right kinds. They are looking for plants that grow well in bad weather, start growing quickly, and are cheap.

They are testing some pasture plants—crown vetch, red fescue, Canada bluegrass, and several lespedezas. They have found flowering plants that stopped erosion along new highways in Georgia. Iris and daylilies have added beauty to the roadsides there.

But, scientists are not testing just quick-growing or colorful plants. They

Spun glass fibers keep the soil from blowing and let the water soak in.

are trying other new ways to hold down fresh-bared soil. They spray liquid asphalt after planting a cover crop. The asphalt acts like hair spray to keep down the windblown look. It is tacky enough to keep soil from blowing or washing but loose enough to let the seedlings break through. Spun glass fibers do the same thing. These unusual mulching materials can be sprayed over large areas quickly and at reasonable cost. They make a blotter of the soil, keeping it porous to let the water soak in.

Silt basins are another way to reduce silting of streams from bulldozed acres. These are simple, dammed-up areas, located in the path of draining storm water. They slow down the water, letting it drop its load of silt before running into nearby streams.

But these, too, are answers born of desperation. As our population grows larger, our open land grows smaller—our rich soil is washed down the creeks, down the rivers, into the sea. These small answers to our large troubles have been good. But we need more information to let us find more answers. And soon—before our large troubles get even larger.

Silt basins are another way to slow down water to let it drop its load of silt before draining into nearby streams.

Questions.....With Answers Through Research

Question: How much water do we have in this country, and how much of it is usable?

Question: What happens to water during its endless journey from air to mountainside to stream to lake or ocean to air?

Question: How much water soaks into the earth, how much evaporates?

Question: How much water works *for* man, how much *against* him?

These questions—and thousands more—are being answered by scientists who work on the Agricultural Research Service's soil and water conservation program.

Every place in the world, including your own suburban home, depends for its water on a watershed—the hills and fields from which water drains to a single channel. Since only a small part of the rain and snow falls in your yard, or your block, the story of the water you drink really begins farther away—all the way to the edge of your watershed. It begins there even if you pump that drink from your own backyard well.

When scientists study a watershed, they learn everything they can about the water that falls on it, flows over it, or soaks into it. They ask the people who live in the watershed to help. Then the study may blossom and bear fruit, as in a model watershed development program. From this comes flood control in wet areas and more water in dry areas. Ponds or lakes bring water fun and sport. Equally important, each watershed study helps us to better understand the other watersheds of our Nation.

Stream gaging station on Sleepers River gives research information on flood flows and water yields from steep mountain streams.

The Sleeper's River experimental watershed in Vermont is one of the smaller watersheds being studied. Though only 43 square miles in size, the Sleeper's River Basin has important characteristics. Its hills and valleys are typical of the glacier-scoured uplands of the Northeast. And in these uplands are formed the streams that carry water to the large cities on the nearby coast.

Hydrologists—scientists who study water—installed a network of weather- and stream-measuring stations in the watershed. Weather station instruments measure evaporation, wind direction and speed, how bright the sun shines and for how long, water and soil temperatures, and atmospheric pressure. Stream-measuring equipment records changes in water level and movement. Snow measurements are taken once a week throughout the winter.

Hydrologists also study the physical characteristics of the area that might affect water supply—the slopes, soil texture, underlying rock, and types and amounts of soil cover.

The gathering of this basic information was started 10 years ago at Sleeper's River. Scientists think it will give us a clear picture of how water changes and is changed by an area. We will get information that will help ensure future water supplies for cities of the

Electronic computers turn records on the amount of water that falls in a watershed into a prediction of the amount of water that will flow out.

Northeast. Similar studies in other regions will help solve their water problems.

Because we need watershed information so badly, our scientists are looking for new ways to collect and examine it. Electronic computers can help. Mathematical formulas are being developed for testing watershed information. These formulas, fed into computers, will help us use what we know about experimental watersheds—like Sleeper's River—to develop rules that apply to many or perhaps all watersheds.

When our scientists study water movement, they must take into account the shape of the land, the plants on top of it, and the soil and rocks underneath. All these change the amount and the time of water movement at any downstream point. Computers turn records on the amount of water that falls in a watershed into a prediction of the amount of water that will flow out.

Researchers are studying soils to find out how much rainfall each soil can store. And they can find out how fast water will soak through each soil.

Once scientists know how much water will soak through different soils of a watershed, they can predict the amount of runoff from any rainstorm or from several storms. This information will help us plan and build dams and spillways, lakes and ponds, levees and channels. All these help control swollen streams. The information will help, too, in estimating irrigation water supplies and forecasting floods.

When snow falls on this "pillow," a pressure gage measures the weight of the snow and tells its water content.

In some areas, like the Pacific Northwest, snow is even more important than rain as a source of water. To gather watershed information in mountainous areas, our scientists use aerial mapping to help them estimate the amount and depth of snow cover. They also are testing a rubber pressure pillow to help in measuring the water content of snowfall. The pillow is 12 feet across and filled with antifreeze. When snow falls on it, the antifreeze pushes on a man-

ometer (a pressure gage) that measures the weight of the snow and in this way tells its water content. Aerial mapping and the snow pillow are both new ways that promise to save many man-hours over the old ways of measuring a snowfall.

We also have some new answers to the problem of too little water. In the ancient deserts of Persia, farmers brought water from the mountains through miles of tunnels to storage wells from which they irrigated their crops. We, too, bring water through miles of tunnels to our reservoirs for storage. Here, though, we lose millions of gallons of this carefully carried water—through evaporation.

Evaporation is water trouble, too. And so, our scientists are hunting for ways to stop, or at least slow down, evaporation from open water. They already have found a harmless chemical—a wax used in lipstick—that promises to help.

This wax is mixed with a kind of sugar. Small amounts of the mixture are floated on the water's surface where the sugar slowly dissolves and the wax spreads out to reduce evaporation—as much as 40 percent over a 2-week period when tested on a large outdoor tank.

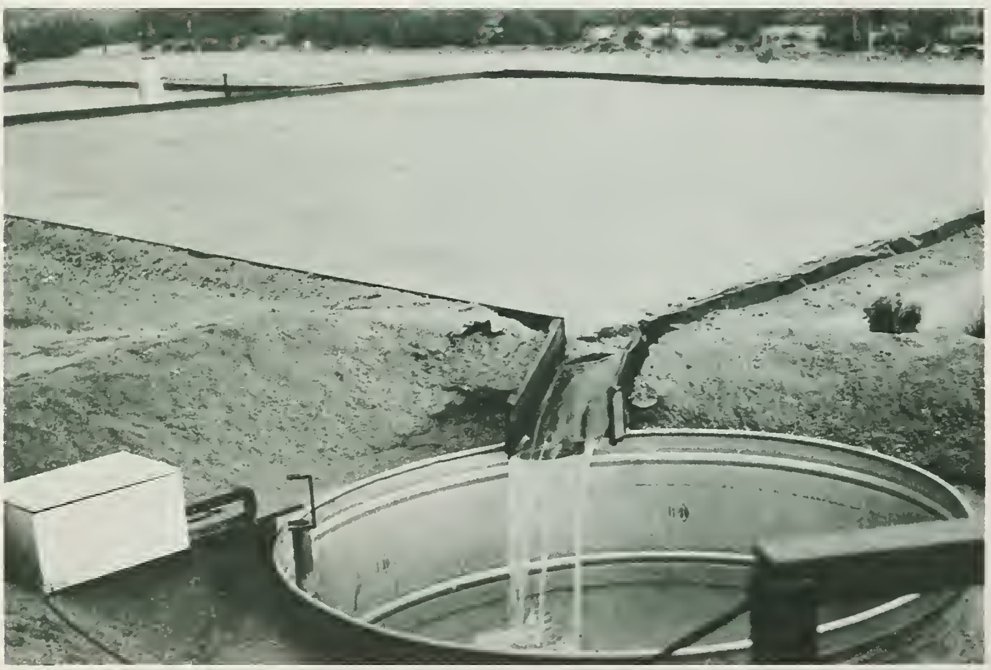
Ways to slow down evaporation become important when you think of the 5 trillion gallons of water that each year evaporate from small farm ponds and reservoirs in the 17 Western States. That's enough water to supply all the households in the United States for 1 year—or all the cattle in those same Western States for more than 20 years.

Irrigation research scientists found a way to save billions of gallons of valuable—and scarce—irrigation water in the Western States. It consists of an improved sealer and an efficient method of applying it to weather-cracked concrete irrigation canals. Three men can treat 800 feet of cracks in an hour.

Before repairs, a leaky canal in Arizona's Salt River project lost more than 900 million gallons a year (worth about \$8,400) from each mile it ran.

When it comes to getting more water, man thinks of drilling wells, damming rivers, desalting oceans, and even bombing clouds. But except for putting a pot under the leak in the roof, he seldom tries to catch ordinary rainfall.

Countless billions of gallons fall



Catching rainwater is simple . .

every year, even on deserts. Much of it evaporates right back into the air without serving any useful purpose. This unused water—clean, soft, and ours for the saving—may be a valuable addition to our water supplies.

Catching rainwater is simple, our scientists say. All you need is a smooth, reasonably waterproof surface that slants toward a container to hold the water as it runs off. How much it will cost to harvest water this way depends on how much rain falls. A 1-inch rainfall is nearly 6 gallons of water a square yard—about 25,000 gallons per acre. The amount of land you must waterproof to catch the amount of water you need determines how much money you must spend on waterproofing materials. Our scientists say that you may be able to waterproof your hillside for as little as 100 dollars an acre per year.

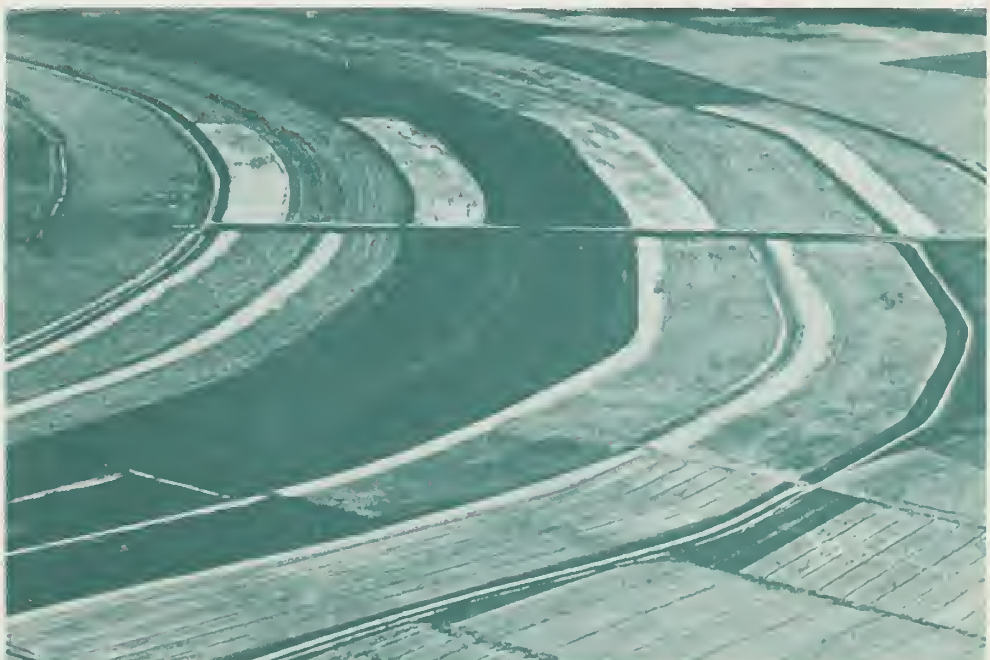
One rain trap our scientists are trying is a rubber sheet 100 feet square that drains into a blimp-like rubber bag that will store 50,000 gallons. A pipe runs from the bag to a stock watering tank, and a float valve regulates the flow of water from bag to tank. In semiarid regions of our country, much land would be suitable for grazing livestock if drinking water were available.

These same principles of water harvesting may someday supply added water for our cities and our industries.

Other billions of gallons are lost on our farms because of wasteful runoff, evaporation, and weeds. Some answers have been found, some are hiding still.

In dry areas, researchers have found new ways to store water in the soil. Terraces already are widely used in wet areas to cut down erosion or to hold water for crops like rice. A new kind of bench terrace spreads runoff water over a wide, level area to allow it to soak in slowly and deeply. The deeper the water is stored, the less likely we are to lose it through evaporation. Deep plowing can help, too, in getting water to soak in instead of running off. In Texas, water stored in the second and third foot of clay loam soil increased cotton yield—each extra inch of water per acre brought an extra 100 pounds of cotton.

In the Southern High Plains of New Mexico, Oklahoma, and Texas are many undrained basins, called playas. Soils in the playa floors are virtually impermeable; consequently almost all the water



A new kind of bench terrace spreads runoff water over a wide, level area to allow it to soak in slowly and deeply.

Treatment with herbicide pellets worked best in ridding some areas of honey mesquite—a moisture-robbing bush.

that collects in playas is lost to evaporation.

For some time, scientists have experimented with wells to drain the playas and store this water underground for later use. Mud in the water has been a major obstacle; sediment quickly plugs up the wells. Filtering systems have been used, but these are difficult to clean and operate.

Our scientists found that inexpensive, easy-to-apply chemicals can clean muddy surface water and make it fit to be put back into the water table. Adding a mixture of alum and cationic polyelectrolyte to the water reduced sediment content by 90 percent. Cationic polyelectrolytes are compounds that, because of their positive electrical charge, cause fine sediment particles to cluster and settle.

These chemical cleaners could save as much as 85 percent of the water that now evaporates from the playas.

The semidesert range areas of the Southwest are being invaded by honey mesquite. This troublesome bush robs the grasses of moisture in the soil.

Once the grass cover is reduced, spring winds blow sand into dunes. Reseeding with grass often is not successful because the weather is so hot and dry. So, our scientists have looked for ways to get rid of the mesquite early—before grass cover is destroyed. They found that treatment with pellets of a herbicide worked best in some areas while spraying with another herbicide did well in others. Sometimes, when there were only a few plants, digging them out by hand was the only answer.

Homeowners know from sad experience that grass seedlings will not emerge in dry soil. Dryland farmers know this, too. If they seed at the regular planting depth, the soil doesn't have enough moisture to germinate the seed or to support seedling growth; if they increase planting depth to reach moisture, the seedling may not be able to grow all the way to the soil surface.

To help overcome this problem, scientists chose strains of intermediate wheatgrass that have longer coleoptiles—the part of the seedling that first grows through the soil surface. Now it will be possible to seed deeper, in moist soil. The seedling will emerge and grow, and its roots will hold down the soil when the wind blows.

Range conservationists and engineers developed ways to seed crested wheatgrass and Russian wildrye on land where rainfall averages only 10 to 15 inches each year. They had to make a special grain drill for planting, test many kinds of grasses, and find which row spacing and depth of seeding worked best.

Salinity is a problem in our arid West. Salt in the soil already has hurt a fourth of our irrigated land. More than half is endangered.

Irrigation water may contain several hundred pounds or even several tons of dissolved salt per million gallons. Plants in irrigated fields absorb the water, but leave nearly all the salt behind in the soil. There it accumulates and eventually prevents plant growth—unless we do something about it.

Sometimes we can wash the salt out of the soil, but this is wasteful of precious irrigation water. Some types of salt-injured soil can be reclaimed by plowing to depths of 3 or 4 feet.

We are searching for salt-tolerant crops. Plant scientists at the Agricultural Research Service's Salinity Laboratory in Riverside, Calif., are trying to learn the mechanism of salt injury to plants and the physiological basis of salt tolerance.

One of the most fascinating scientific achievements of recent years has been development of the laser.

A laser—Light Amplification by Stimulated Emission of Radiation—is an electronic device that amplifies normal light and projects it in a narrow beam. Laser light waves are closely packed and parallel, rather than scattered in all directions like regular light waves.

Recently we put the laser to work for agriculture. Our scientists built a ditching machine that can be controlled by laser beam, making possible uniform ditch depths and grades in spite of irregularities in the surface of a field. A laser beam is directed across the field; a sensing device on the ditching machine focuses on the beam and adjusts ditching depth as necessary. This system of automatic grade control will give farmers in humid regions a fast, efficient method of installing field drains.

Automatic grade control will speed many other earthmoving jobs. The bulldozers used to grade construction sites can be adapted to automatic grade control. Community water, sewer, and storm drain facilities can be dug by laser-directed excavators. Lasers can align the machines that dig beds for highways and the machines that lay paving on the highways. Construction of parks, walks, parking lots, curbs, gutters—almost all of the routine building chores that a growing community must face—can be done more easily because of our research with the laser beam.

All these studies are aimed at saving water and soil. And, as more and more water is needed by our increasing population, our scientists must look for still more ways to save the water we have. More ways to save our soil are needed, too, so that we will have a place to raise the food for the added millions.

Research can help save this water—trillions of gallons—and save this soil—millions of acres. For you to use. For your children. And for theirs.

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TOUR GUIDE

OPEN HOUSE

September 28, 1967

AGRICULTURAL RESEARCH CENTER

Beltsville, Maryland

AGRICULTURE/2000

UNITED STATES DEPARTMENT OF AGRICULTURE

TOUR GUIDE

Scientists of the Agricultural Research Center welcome visitors to their laboratories, greenhouses, and field research locations on the occasion of the Open House held as a part of "Agricultural Science Week -- 1967."

A walking tour and two bus tours, described in this leaflet, supplement the tent displays in the Main Exhibit Area at ARC - West (Plant Industry Station). On these tours, visitors can see some of the actual locations where ARC work is carried on and talk directly with scientists engaged in this research.

The walking tour includes laboratories in buildings near the main exhibit area and in one greenhouse range.

Each of the two bus tours has its own starting point near the main exhibit area (see maps). One tour covers ARC - West (Plant Industry Station), where most of the research is on crops and soils. The other bus tour goes to ARC - East, where work is under way in animal husbandry, entomology, agricultural engineering, pesticide regulation, human nutrition, and other fields of research.

Buses leave for the stops on these tours at 10-minute intervals.

Maps in this leaflet, showing the stops in each tour area, will help you find the research locations you wish to visit. Brief descriptions of what can be seen at the various locations follow:

ARC - WEST

Walking Tour (see map of West area; follow signs).

A. FRONTIERS OF SOILS RESEARCH
Location: Soils Building (south of tent area).

Researchers in the ARC Soils Laboratory study the behavior of soil as a medium for plant growth, evaluate methods of conserving and improving soil for continuing productivity, and investigate problems of soil contamination. You can see demonstrations of this work in Rooms 101, 109, 128, and 201 of the Soils Building.

B. PLANT HORMONE RESEARCH
Location: West Building (north of tent area).

Pioneering research to discover how hormones and growth-regulating chemicals affect plants is conducted in this laboratory. Some of the current work will be shown to visitors.

C. PLANT VIROLOGY LABORATORY
Location: West Building.

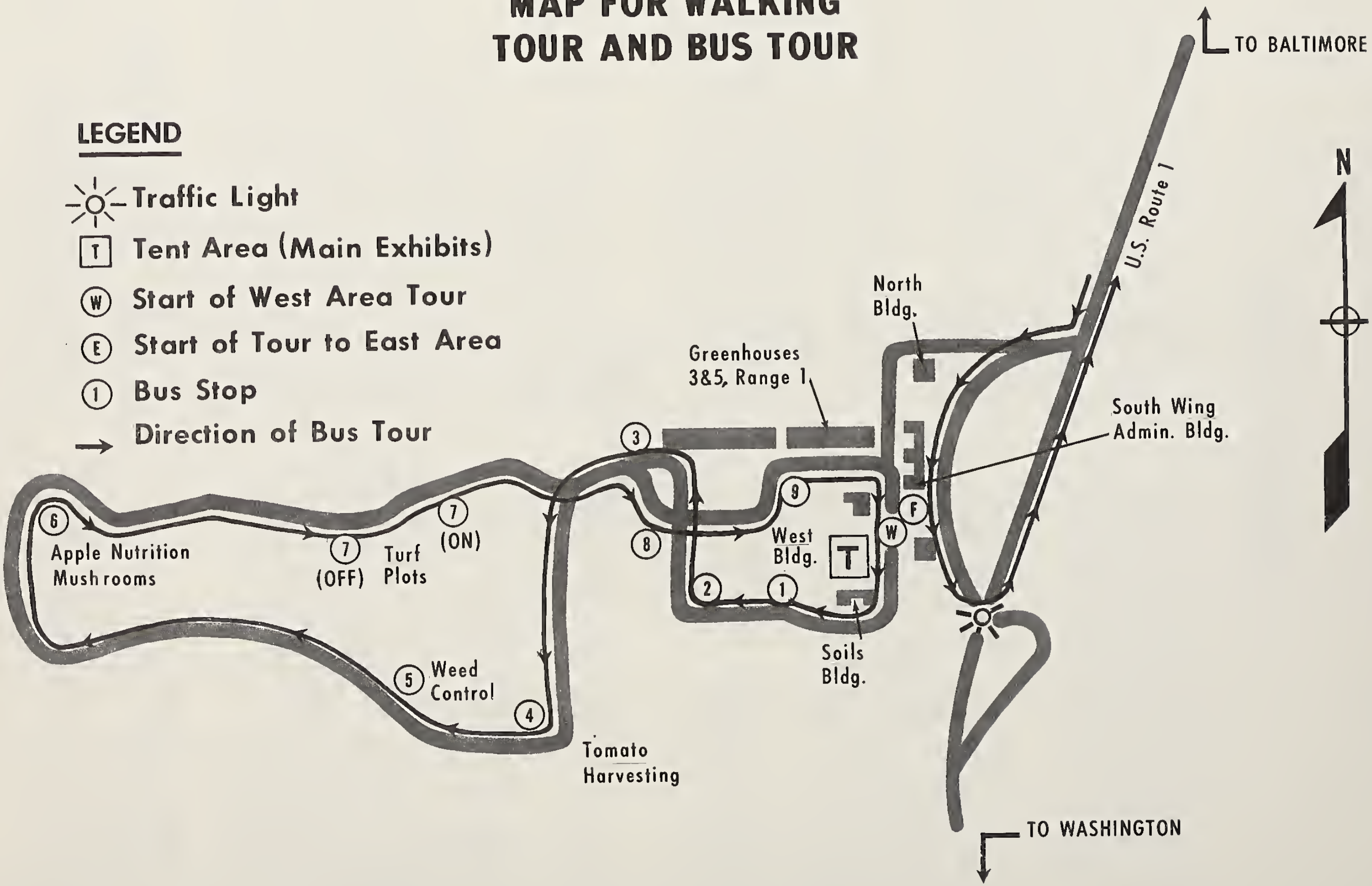
Researchers will demonstrate several methods used in this laboratory to purify viruses and test the samples for purity. In a nearby greenhouse (see STOP 2, ARC - West bus tour, Page 6.) you can see plants exhibiting the symptoms of different viruses and also a series showing the range of symptoms caused by one virus on different host plants.

D. MARKET QUALITY LABORATORY
Location: South Wing, Administration Building.

Demonstration showing how sound vibrations, light transmission, and light re-

ARC - WEST

MAP FOR WALKING TOUR AND BUS TOUR



flectance are used to measure firmness, interior and exterior color, and other food quality factors in fruits and vegetables without physically damaging the produce tested.

E. ENTOMOLOGY RESEARCH

Location: North Building, Plant Industry Station.

Closely integrated scientific teams of entomologists, chemists, biologists, and researchers in other disciplines work at ARC laboratories on biological, physical, and chemical means of fighting insects. Four examples of this research are:

1. Work to better understand bee pollination, breeding, physiology, and diseases;
2. Taxonomy of entomological species, to increase man's knowledge of economically important pests, and permit rapid identification of species submitted by officials responsible for protecting America's crops and livestock from invasions of foreign insects;
3. Influence of light on insect behavior;
4. Use of cockroaches and other insects in tests of promising new insecticides, and breeding of standard laboratory animals that will provide uniform toxicity responses to such insecticides.

Other research in entomology may be seen on the ARS - East bus tour described on page

F. SMALL PORTABLE HOTBED

Location: Greenhouse 3, Range 1.

This device can help suburban home gardeners. It is a portable hotbed and propagating frame, used in spring to grow early vegetables and flowers and in summer and fall to root cuttings of ornamentals, such as azaleas, rhododendrons, and forsythia.

G. VIRUS DISEASES OF BEANS

Location: Greenhouse 5, Range 1.

The effects of certain viruses on bean plants--malformation of leaves, stunting, and other symptoms--are shown on live plants and contrasted with the appearance of healthy, resistant plants.

Bus Tour

STOP 1

PLANT RESPONSE TO SOILS

The genetic makeup of a plant variety determines its ability to adapt to the soil of a particular region. Demonstrations show how plants differ in nutrient requirements and in tolerance to toxic factors in soils.

PESTICIDES AND SOILS

Scientists at this laboratory are determining what happens to pesticides after they are applied. They study the effects of light, water, temperature, and microorganisms on pesticides in soils. These basic studies, part of a major investigation of the fate of pesticides in our environment, are designed to find ways of improving pesticide effectiveness and avoiding potential residue hazards.

EVALUATION OF NEW HERBICIDES

New chemicals are evaluated for their herbicidal properties in this facility. Weed-control experiments and experimental equipment in laboratories, controlled climate chambers, and greenhouses are displayed.

NATURE OF PLANT DISEASE RESISTANCE

Little is known about the physiological, metabolic, and anatomical nature of plant disease resistance. This newly established laboratory investigates this area of research to assist other scientists in developing improved methods of plant disease control, including development of new varieties and new biological and chemical techniques.

STOP 2

PHYTO-ENGINEERING LABORATORY

Bringing outdoor weather into the laboratory helps scientists study the effects of environment on plant growth. This is done in the Phyto-Engineering Laboratory. Here plants are grown indoors in a simulated,

completely controlled "outdoors." In the laboratory's experimental chambers, ARS researchers regulate the quality, intensity, and duration of light, temperature, and humidity, and control the chemical nutrients supplied to the plants. They can then study the effects of these variables on seed germination, photosynthesis, stem elongation, flowering, aging, and other plant-growth phenomena. The scientists seek new ways of accelerating plant development, or otherwise manipulating the behavior of plants, to produce more food for the world's future needs.

TOBACCO SUCKER CONTROL

Effective, safe chemicals are sought in this work to control sucker growth on tobacco plants. Plants on display in the greenhouse show how different chemicals inhibit bud (sucker) development at different stages of the plant's growth.

PLANT VIROLOGY

(see also Walking Tour, item C)

Greenhouse plants are shown that exhibit symptoms of different viruses; others illustrate the range of symptoms caused by a single virus on different host plants.

DISEASE AND PLANT METABOLISM

This exhibit shows how ARC scientists determine the effects of disease organisms on cereal plants. Healthy and diseased plants grown in a controlled environment are compared to show how disease organisms affect plant metabolism and cause reduced yields and poor quality products.

STOP 3

FOREST TREE PHYSIOLOGY

This exhibit shows stimulation of tree growth by mycorrhizal fungi, developmental changes in embryonic shoots of spruce trees, and nutritional responses of pine trees in sand culture.

SOYBEAN NODULATING BACTERIA

Strains of the soybean nodulating bacteria Rhizobium japonicum differ in their ability to "fix" atmospheric nitrogen. This exhibit demonstrates nodule selection and a serological agglutination technique used for rapid identification of strains. The procedure enables scientists to evaluate nitrogen-fixing ability under field and greenhouse investigations.

STOP 4

TOMATO HARVEST BY MACHINE

Machine harvesting is practical for tomatoes grown from selections developed especially for this purpose. Such tomatoes have small vines producing a concentrated set of fruit, all ripening at the same time. The fruit itself has proper resiliency and shape for mechanical harvesting. You will see the machine in operation.

STOP 5

WEED CONTROL IN ENGLISH IVY

English ivy is widely planted as a soil holder along roadsides, around new homesites, and in public parks. It provides good ground cover, keeps the soil from eroding, and adds beauty. To get the planting well started, weeds must be controlled. ARC research is showing how the job can best be done. The results are illustrated by a series of ivy plantings treated with herbicides and combinations of herbicides of known effectiveness.

STOP 6

APPLE NUTRITION

Deficiencies in minor elements needed for good plant nutrition can cause many disorders in apple trees. To pinpoint these deficiencies, apple trees are grown in made-to-order cultures from which specific minor elements have been left out. The results can be studied when the trees reach fruiting size.

MUSHROOM GROWING

A live demonstration of growing mushrooms, including both healthy and diseased specimens, and an experimental crop at the peak of its production.

STOP 7

TURF RESEARCH

Turf specialists at Beltsville are conducting research on warm- and cool-season turf grasses to provide information needed to produce better lawns. On a brief walk through the turf plots, visitors will see the results of some recent turf-management and variety-improvement studies.

STOP 8

Pickup point: Buses returning to Main Exhibit Area, via STOP 9.

STOP 9

PLANTS AND LIGHT

To bring chrysanthemums into flower during the summer in northern States, growers must shade the plants to reduce the day-length. This is necessary because chrysanthemums are short-day plants. Many other plants, such as soybeans and corn, must have long days and short dark periods to mature. This response to light is known as photoperiodism. How man can regulate light duration and use different types of light to control plant development is shown here in the Plant Physiology Laboratory.

MADE-TO-ORDER ORNAMENTALS

Scientists are working to produce "tailor-made" ornamental plants through breeding, disease control, and chemical regulators. Shown in this exhibit is some of the research on viruses of ornamentals, black spot of roses, chemical pruning, breeding of poinsettias, regulation of azalea flowering, and promotion of dormancy.

ARC-EAST

Bus Tour

STOP 1 - Dairy Cattle Research

ENERGY METABOLISM LABORATORY

Studies here help scientists learn what actually happens to the feed a cow eats--for instance, what proportion of the diet goes into milk production. You will see plexiglass chambers with cows sealed temporarily inside, where all the energy used by the animals can be measured, including amounts devoted to body movements, body heat, breathing, etc. The cows eat, sleep, and are milked inside these chambers. There is also a "robot" system for continuously recording information about conditions inside the chamber--such as the composition of the atmosphere--by typewriter on computer punch cards without human aid.

DAIRY BREEDING

Calves ranging in age from 1 day to 6 months old, produced at ARC, are shown and the results of the breeding program explained.

STOP 2 - Agricultural Engineering

RESEARCH TOOLS

Agricultural engineers design and test a wide variety of equipment vital for research progress. Examples:

Thermometer radio, which takes a man's temperature and transmits a running account by transistor radio to an automatic recorder. Other equipment to record temperature, humidity, and other data in hard-to-get-at places is shown.

Light, radiation, and energy meters. This equipment is used in projects ranging from studies of insect traps to determination of the energy needed to make plants grow.

Black light and ultraviolet-ray insect traps.

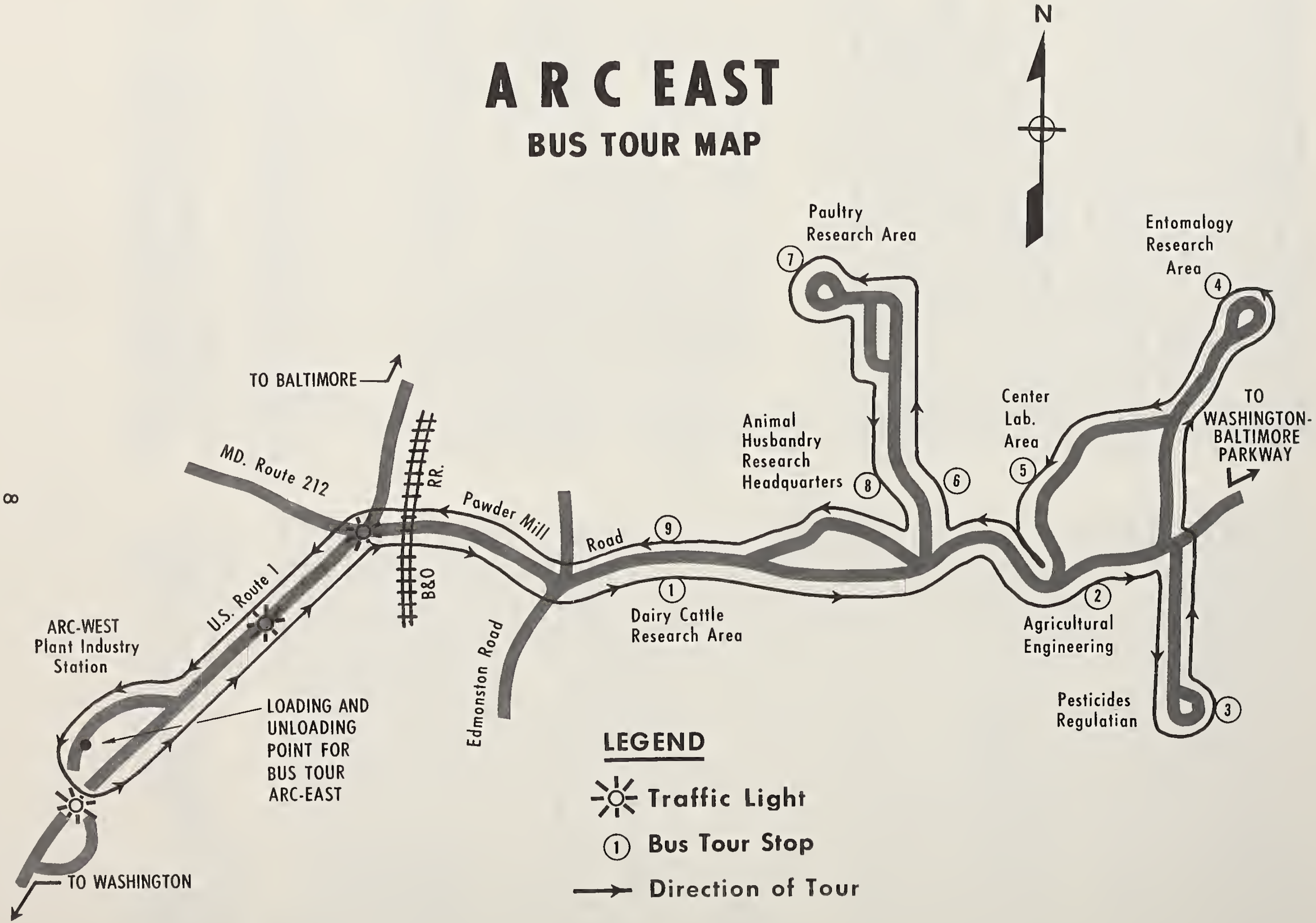
Eggshell-strength tester, which can determine by nuclear energy how thick an egg shell is without breaking it.

FARM MACHINERY

Experimental machines on display will include a grass seeder, potato planter, and liquid fertilizer applicator.

A R C EAST

BUS TOUR MAP



STOP 3 - Pesticide Regulation

INSECTICIDE TESTING

Here promising new insecticides are tested for effectiveness and possible hazards to humans, animals, or plants. On view:

Greenhouse plots infested with spider mites, aphids, mealybugs, and other insects, showing the difference between plots treated and not treated with insecticide.

Outside plots that illustrate treatments against bean beetles, cabbage worms and other insect pests.

Test chambers that show the effectiveness of aerosol bombs and sprays against household pests.

Exhibits of major insect pests against which insecticides are being tested.

TESTS OF OTHER PESTICIDES

On view: Chemicals that kill fungi, weeds, algae in water, and nematodes. Chemicals that stimulate or retard plant growth and strip leaves off plants for easier harvest. Plots treated with these chemicals compared with untreated controls, including giant and dwarf plants that have been adjusted for height with special sprays.

TESTS OF GERM-KILLING AGENTS

On view: Samples of the wide variety of disinfectants tested by USDA. A typical test of a disinfectant advertised as active against athlete's foot will be demonstrated. The product is applied to a surface seeded with athlete's foot fungus. After allowing time for the disinfectant to do its work, the surface is scraped, and the scrapings are cultured in a test medium. The difference in appearance of the test media are shown after successful and unsuccessful tests.

STOP 4 - Entomology Research

"DERAILING" INSECT GROWTH

Entomologists are exploring many new ways to fight insect pests without the use of chemicals that may be hazardous to man, domestic animals, or wildlife. One recent result of this work is the isolation of a "juvenile hormone" that throws an insect's life cycle off the track.

Insects have a complicated growth pattern, starting with an egg and typically proceeding through larva and pupa stages to the adult form. The "juvenile hormone", when applied to insects in the pupal stage, keeps them forever "young" and unable to become adults. Thus, treated insects cannot multiply.

Other insect hormones under study seem to have similar "derailing" effects at other stages of the insect's life cycle.

FIGHTING THE ALFALFA WEEVIL

An all-out war is being fought against this forage-crop pest, which causes heavy losses in alfalfa fields. Weapons on view include an anti-weevil flame thrower and parasites that prey on the alfalfa pest. Rearing chambers may be seen where weevil eggs, larvae, and pupae are grown for experiments.

PROTECTING VEGETABLES AND ORNAMENTALS AGAINST INSECTS

New methods to guard flowers, shrubs, and vegetable crops against insect attack are under development. Used in this research are fruit-fly rearing rooms; traps baited with sex attractants or employing "black" light; breeding programs that yield new insect-resistant varieties of crops such as tomatoes.

ANTI-INSECT MICROBES

The continuing search for bacteria, viruses, and other microbes that can attack insects and help free man from dependence on chemical insecticides will be explained and demonstrated.

NEW AEROSOL SPRAYS

Entomologists continue to seek more effective and safer aerosol space sprays to use against household pests. They employ a "fly chamber" to test the knock-down power and long-lasting effects of new sprays.

HEALTHIER HONEYBEES

Honeybees are susceptible to diseases, which cost bee farmers several million dollars in losses every year. Entomologists are working steadily to combat these diseases and keep honeybees in good health. Illustrating this research is an apiarium with 32 bee colonies in glass cases, which afford a clear look into beehive society.

STOP 5 - Center Laboratory Area

HUMAN NUTRITION RESEARCH (Bldg. 308)

The special automated print-out instrument, demonstrated here, employs bacterial growth to measure the amount of a given vitamin present in foods. This versatile research tool can also be used to determine protein and many other nutrients in foods. The analyses are made througn spectrophotometric measurements of sample color or turbidity. Readings are automatically translated and printed on tape, as concentration of the nutrient present.

This instrument rapidly evaluates new varieties of fruits and vegetables and new convenience foods. It compares the nutrient content of foods grown in different areas and processed by different methods. Nutritionists use this information to make dietary recommendations that promote the health and well-being of people of all ages.

STERILIZING INSECTS (Bldg. 307)

Use of screwworm flies sterilized by atomic radiation freed the United States of this destructive livestock pest. Chemicals can also sterilize insects and are being tested for possible use in control programs. When large numbers of sterilized male insects are released to mate with normal females, many of the eggs fail to hatch. Repeated releases overwhelm the native insect population, and it gradually dies out.

UPSETTING THE TIME SENSE OF INSECTS (Bldg. 307)

Like other living organisms, insects have a time sense or "biological clock". They hibernate, much like bears, in response to seasonal changes in sunlight and temperature. Scientists try to control or interfere with this response--for example, by getting moths to come out of hibernation in midwinter and thus freeze to death. At this exhibit you will see how insects can be wakened from hibernation.

SEX ATTRACTANTS FOR PINK BOLLWORM CONTROL (Bldg. 306)

The pink bollworm, a highly destructive pest of cotton plants, responds to sex attractants, as do many other insects. When a female pink bollworm is ready to mate, she gives off a distinctive vapor, which attracts the males. Entomologists plan to use this sex attractant as a lure to trap the male bollworms, in hope of reducing damage to cotton. Pink bollworms ruin about 8 percent of the crop every year, despite all efforts to control them.

You will see the equipment used to obtain the attractant (it takes about a million female moths to produce 1 milligram of this substance) and how it affects the male moths.

TESTS OF PESTICIDE SAFETY (Bldg. 306)

Scientists at ARC analyze commercial pesticides to see that the list of ingredients on the label truly indicates actual composition. They also determine the residues likely to be left on crops or in the soil after agricultural pesticides have been applied.

These scientists show how they differentiate between such chemically similar products as DDT, DDD, methoxychlor, and kelthane, using such methods as infrared spectophotometry, thin-layer chromatography, gas-liquid chromatography, and wet chemistry. They will also demonstrate safety tests on aerosol containers, showing the hazards of faulty containers. Typical pesticides marketed for household and commercial use are on display.

SEED LABORATORY (Bldg. 306)

This laboratory is a facility of USDA's Consumer and Marketing Service. Labels on all packages of seeds marketed in interstate

commerce must list the amount of each variety of seed, inert matter, and weed seeds in the package. Exhibits include samples of seed in germination, technologists separating weed seeds from grass seeds, and displays of various varieties of grass seed.

ATOMIC-AGE INSTRUMENTS FOR RESEARCH ENTOMOLOGISTS (Bldg. 309)

Entomologists use complex instruments to analyze the composition of many new substances, including sex attractants, to better understand their action and to work out methods to synthesize them for mass use. Similar instruments help determine how much residue a pesticide may leave on plants or in soil. These research tools are sensitive enough to detect 1 milligram of pesticide residue in a ton of corn.

A battery of these instruments are displayed, including the 100 mega-hertz nuclear magnetic resonance spectrometer and the rare Model 21-110B CEC mass spectrometer.

STOP 6

BIOMETRICS

This date-processing facility handles research information generated by the hundreds of Agricultural Research Service projects. The system is built around the IBM 1620 computer. Its work will be interrupted to show you what happens to the data at various stages of processing.

PHARMACOLOGY

This laboratory's work includes pharmacological studies to determine the safety of pesticides. You see some of the laboratory animals used in this research--rats, mice, guinea pigs, and rabbits--as well as instruments used to analyze pesticide residues in blood and urine samples, including an auto-analyzer and spectrophotometer.

STOP 7 - Poultry Research

BELTSVILLE SMALL WHITE TURKEYS

A special breed of turkeys was developed at the Agricultural Research Center to meet the need for a small, meaty, turkey suitable for year-round consumption by the average American family. These turkeys have a long, broad breast and produce much meat for their size. They are usually marketed at 15 to 16 weeks of age to produce ready-to-cook turkeys in the 5- to 9-pound weight range. Most of these small turkeys are roasted, but they can also be fried, broiled, or barbecued.

SHORT-DAY LAYING HENS

Egg laying by chickens is influenced by controlling light and darkness. Although hens normally produce no more than 1 egg every 24 hours, poultry researchers wonder if they could increase production by shortening the hens' days to 18 hours. You see equipment (in Building 268) that automatically adjusts the light, temperature, and humidity to mimic the changes between day and night on an 18-hour schedule. A robot automatically checks which hens have laid eggs during each hour. Chicken cages are shown (in Building 269) that are designed and electronically wired so that the robot can make the egg count without human help.

JAPANESE QUAIL

The Japanese quail was imported recently from Japan for research purposes. These birds make excellent research subjects, because their habits are essentially the same as those of chickens. They mature in one-third the time, however, and they can be raised in one-third the space on one-twentieth of the feed needed for chickens.

STOP 8

Pickup point at the BIOMETRICS-PHARMACOLOGY area. Buses returning to ARC - WEST (Plant Industry Station).

DRIVE-BY, Animal Husbandry Research Area

Breeding, feeding, housing, and management of all classes of livestock are directed from the Animal Husbandry Research Division Headquarters. Some of the research is done at this laboratory.

On view, from your bus:

Meat Laboratory to study quantity and quality of red meat produced in various livestock feeding trails.

Small Animal Building housing rats, pigeons, guinea pigs, and other small animals used in basic studies on animal biology.

Heating plant and office building.

Cattle and hog barns. In typical experiment conducted here, cattle are raised on feeds that contain no natural protein. Researchers are trying to promote the growth and effectiveness of bacteria in the first stomach to help cattle convert simple chemicals into protein. Thus a cow is turned into a "protein factory," important for a world in which protein-rich foods are, or will be, in short supply.

STOP 9

Pickup point at the Dairy Cattle Research Area. Buses returning to ARC - WEST (Plant Industry Station).

science and FOOD FOR FREEDOM

AGRICULTURE INFORMATION BULLETIN No. 317 U. S. DEPARTMENT OF AGRICULTURE

science and FOOD FOR FREEDO

Half the men on earth are badly fed or close to starvation. So, let's talk about food. Not about what **you** ate for breakfast. But about what **he** ate—or didn't eat. **He** is halfway round the world from you, but **he** is hungry—and that puts him right next door. For hunger now shapes the world you live in. The long shadow of hunger and famine darkens the trail that less developed nations (like his) must follow to freedom. Hungry men make hungry nations.

The problem is food—or rather not enough food. Not enough food growing in his part of the world. Not enough for today's hunger. Tomorrow, more food will grow, but so too will hunger grow as yet another child is born.

This hungry child, if he lives, grows into a hungry man. **He** and his hungry neighbors have needs they can never fill. And the nations they live in cannot take their place in our free world without help.

You have helped, already, by sending him part of your own harvest. And you will send more.

But we—you and your government working together—have found a better way. This better way helps people to help themselves. We find and try out new ways to raise more food or better food. Or how to kill the bugs that demand a share. Then, we show him (the hungry one) how to use these new ways to grow bigger crops.

And yet another hungry child is born—to grow into a hungry man.

And so, we send him food and know-how—both for freedom. With your help—and his self help—his tomorrow can be as bright as yours.

Abundant food—ours through the science of agricultural research—lets us help others. Abundant know-how—through science, too—lets us show others how to help themselves.

Sometimes, we send wheat or soybeans made a new way into familiar, but higher protein, foods. More often, we send our wheat or corn the way it is at harvest. In the last 10 years, we have shared more than 140 million tons of food with the hungry people of more than a hundred countries around the world.

It is the same with our abundant experience. It goes abroad in different forms. Sometimes, we demonstrate in foreign lands the ways that have helped us. More often, we show visitors these ways in our own fields and research laboratories.

We are using our abundance in food and experience to fight against hunger. And we will go on helping others to keep their freedom. But everyone who is hungry cannot be fed until the farmers in every country have found their own ways to make their land rich, their crops big, and their freedom secure.

With your help—and his self help—his tomorrow could be as bright as yours.

What we do . . .

In recent years, we have sold more and more of our abundant food in foreign lands. Three-fourths of this food was paid for in American dollars. The other fourth we gave away or sold to countries that did not have dollars to pay us with—we were paid with their available rupees and pesos. And we use these rupees and pesos to help ourselves and to help others. Indian rupees support studies of food and fodder crops, while Colombian pesos pay for plant disease work. All help bring freedom to the world.

India always has trouble growing enough food for her millions. Worse years have followed bad ones. For several of these years, we sent India a half million tons of grain each month. To help out in her latest trouble, the worst drought in this century, we increased this by 50 percent.

This grain came from the rolling hills of eastern Washington and Idaho and the plains of Kansas and the Dakotas. Our farmers plowed and planted, weeded and watered, hoped and harvested. They made a rich soil richer with the right fertilizers—found by agricultural research. They broke a deep soil with new plows—shaped by research. They planted good seeds—chosen by research. They saved their crops from grasshoppers with better sprays—invented by research. Agricultural research touched every step of the road from farm to flour.

In war-torn Viet Nam, rice is always the main dish on a scanty table.

But, in the mountains near Ban-Me-Thuot, hungry villagers now eat a food that is strange to them. It is bulgur, an ancient food we found a new, better way to make.

In the days of the Bible, bulgur was a favorite food in the Middle East, as it is today. Immigrants brought it to us.

We cook and dry kernels of wheat. Then, we take off the outer layers of bran and crack the kernels. The result is bulgur. Bulgur is the color of toast and rich in wheat flavor. It cooks in about 20 minutes, and soaks up juices easily.

Our research laboratories worked out this new way to make bulgur. We tested it and tasted it. We puffed it and pressed it. We cooked it and canned it. In the past 3 years, our wheat millers have made four hundred million pounds of it.

Fried or frozen, chopped or chipped, ground or grated—most foods change shape before we eat them. The change is to make them look better, taste better, ship better, or keep better. Sometimes all four. And agricultural research looks for new and cheap ways to do these things.

Our hungry neighbor lives far away. His weather is hot and his trains are slow. Food for him needs a special touch to make it keep until he can eat it. We look for—and find—ways to do this, too.

Our scientists help export our experience by teaching in foreign agricultural colleges. They also teach students from foreign lands who come here to study in American colleges.

During the past year, 300 of our

scientists and technicians went to 39 foreign lands to help grow more food. They took with them our abundant know-how, tested and proved in 100 years of agricultural research.

At the same time some of the world's best foreign scientists did research paid for by more than 775 grants of foreign money, that we got from selling American food in hungry nations. Public Law 480, passed by the Congress, provided for the use of this money where we sold the food.

The foreign scientists did their research in 30 nations on every continent except our own. These grants so far add up to about $48 million in foreign money. The things we learn from this research will help grow more food in the nations where the research is done —and the knowledge gained also will help us.

Our agricultural research has—

- Helped grow a new millet that gives nearly twice as much grain as India's best local varieties.
- Helped Vietnamese farmers grow four times as much corn in 4 years.
- Protected millions of cattle in four West African countries against a dread disease, rinderpest.
- Developed a way for hungry villagers to make their own soybean flour, in five easy steps.
- Made possible eradication of one of the world's worst insect pests, the malaria mosquito.
- Found a new hybrid corn that gives twice as big a crop on a hundred thousand African acres.

Our scientists are working now in India to help that country cut down the birthrate of marauding sacred cattle. To prevent conception by these cattle, Indians have begun using a plastic spiral (intrauterine device) tested on cows at the Agricultural Research Center, Beltsville, Md.

The Middle East is a part of the world where controlling insects once meant driving them from the fields with horns, sticks, fire, or magic spells. In 1951, we were asked to help fight the locust plagues that have come each year since time began. We brought airplanes, chemicals, and know-how—our own magic. We showed the people how to help themselves with surveys, quarantines, and control programs of their own. Millions of people in the hungry Middle East now eat the food that locusts used to get.

Agricultural research . . . helped Vietnamese farmers grow four times as much corn in 4 years.

Agricultural research . . . brought chemicals and know-how to help fight the locust plagues.

What we can do

What we are doing now is making a start toward helping to feed a hungry world. But many problems are still ahead.

Seeds are a bright promise not yet kept. And we need to make this promise even more bright. We need seeds for better wheat and rice, better sorghum and millet, better chickpeas and soybeans, and better corn. For seeds are most of what we eat. They are almost all of what **he** eats.

To bring these better seeds near this bright promise, we need better fertilizer. And, especially, more fertilizer. More fertilizer on the fields of hungry nations.

We need to learn how to control (and then get rid of) some of the worst livestock diseases, such as African swine fever and foot-and-mouth disease.

Our studies in Africa have found that one hog with African swine fever can give it to another. Scientists in Spain are looking for fast ways to tell when a hog has the fever. When we find out how to do this, maybe we can get rid of the disease.

The recent outbreaks of foot-and-mouth disease in Europe are a threat to raising cattle anywhere in the world.

Research on these two diseases, and other animal diseases of the world, is done in foreign countries and at our Agricultural Research Service Plum Island Animal Disease Laboratory, Greenport, N.Y.

We can raise more food in many parts of the world if we can kill some insects. These are the insects that eat crops, kill livestock, and bring sickness and death to man. Our agricultural scientists have proven ways to control most of these pests—

- They developed ways to kill mosquitoes, and by doing this saved many men from malaria and yellow fever.
- They also got rid of the screwworm flies in our country by using sterile insects. This same way can be used against screwworm flies in Central and South America.
- A team of our researchers in Africa is nearing its goal in studying ways to sterilize tsetse flies. These are the flies that carry sleeping sickness to humans and nagana to livestock.
- Our entomologists are working with the World Health Organization all over the world to find diseases that can be used against insects that carry human disease.
- And this Nation already has a wealth of experience in controlling insect pests that destroy crops while they are in the field, being shipped, and being stored.

We are making a start toward feeding a hungry world—but many problems are still ahead.

But, the world has always had more hungry men than it could feed.

One solution for this problem is to make familiar foods more nutritious. Studies are pointing to new kinds of rice that have more protein and give a bigger crop.

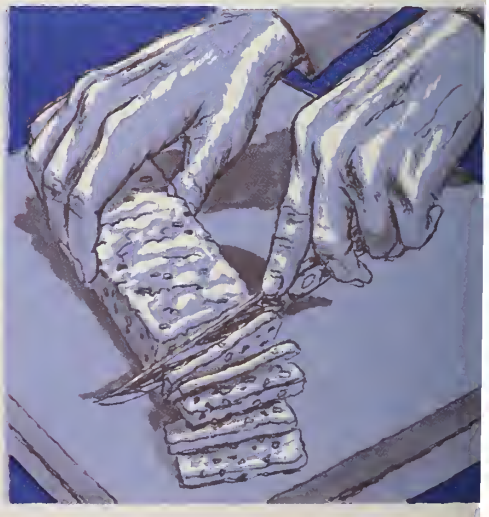
Another solution is to find new ways of turning present crops into familiar foods—to suit the Oriental taste we found new ways of making soybeans into soup stock (miso), uncured cheese (tofu), and fried chips (tempeh).

A third solution is to find new sources of protein and get the hungry people of the world to eat them. This may mean showing the Vietnamese housewife how to use bulgur, making drinks and soup from full-fat soy flour for Taiwanese children, or helping the Thai farmer grow a crop new to him—for instance, corn, a good source of protein, for his own hogs and for export.

Hungry men can plan ways to raise more food only after they have counted their own fields. They need to know their own resources. Our scientists are working with the space program to

Agricultural research . . . can find new sources of protein for the hungry people to eat. WURLD wheat, rich in vitamins and protein, is such a food.

Agricultural research . . . finds new ways of turning present crops into familiar foods—and ferments soybeans for fried chips (tempeh).



Agricultural research . . . finds new foods. Any villager can use simple machinery to make soy flour for drinks or soup. Soak soybeans overnight, then boil them for 10 minutes. Spread them out to dry. Crack them, take off the hulls, and grind the soybeans into flour.

make this easier. Special devices in satellites will help us survey our fields; on a cooperative basis, these devices are available to survey fields in developing nations that request their use.

We hope these devices will tell us—

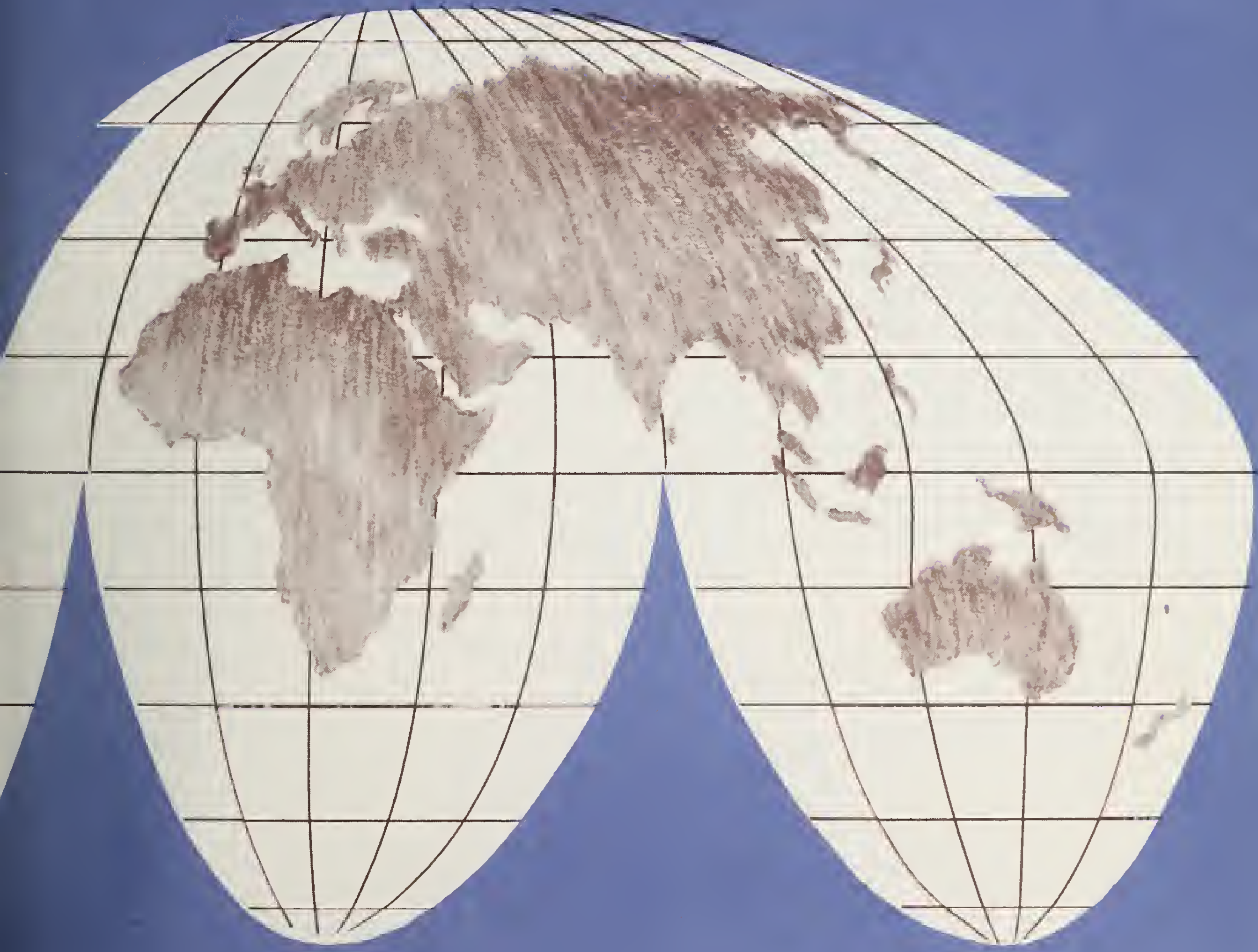
- About the soils. Are they salty, acid, or alkaline? Are they poor or good for another crop?
- About the plants. Are they corn or wheat, grass or tree? Are they healthy or sick, whole or insect eaten? Will the harvest be big or small?
- About the fields. Are they desert dry or rice-field wet? Are they clear or rocky, flat or on edge?

If we are to help feed more and more people, the need for soil and water is urgent. The need becomes even greater in the tropics as new lands are used to raise crops and cattle. Once they control the tsetse fly, for example, Africans can raise cattle in large areas where tall grass, shrubs, and trees now hold soil and water on the land. If heavy grazing—or row cropping—takes off this cover, loss of soil and water could become a serious problem.

Some of these world problems are only partly solved. We still need to help with—

- Crop and livestock marketing, processing, and shipping.
- Irrigating and draining for better use of the soil and water we have.
- Testing soil and adding fertilizer that the crop needs.
- Storing grain and protecting the stored grain from molds and insects, such as the khapra beetle.
- Controlling weeds that use available water and plant food that would otherwise be used in growing crops.

But most of all, we need to talk about food. About what **he** will eat. For in our tomorrow—and his—must be the food to bring freedom from hunger for all.



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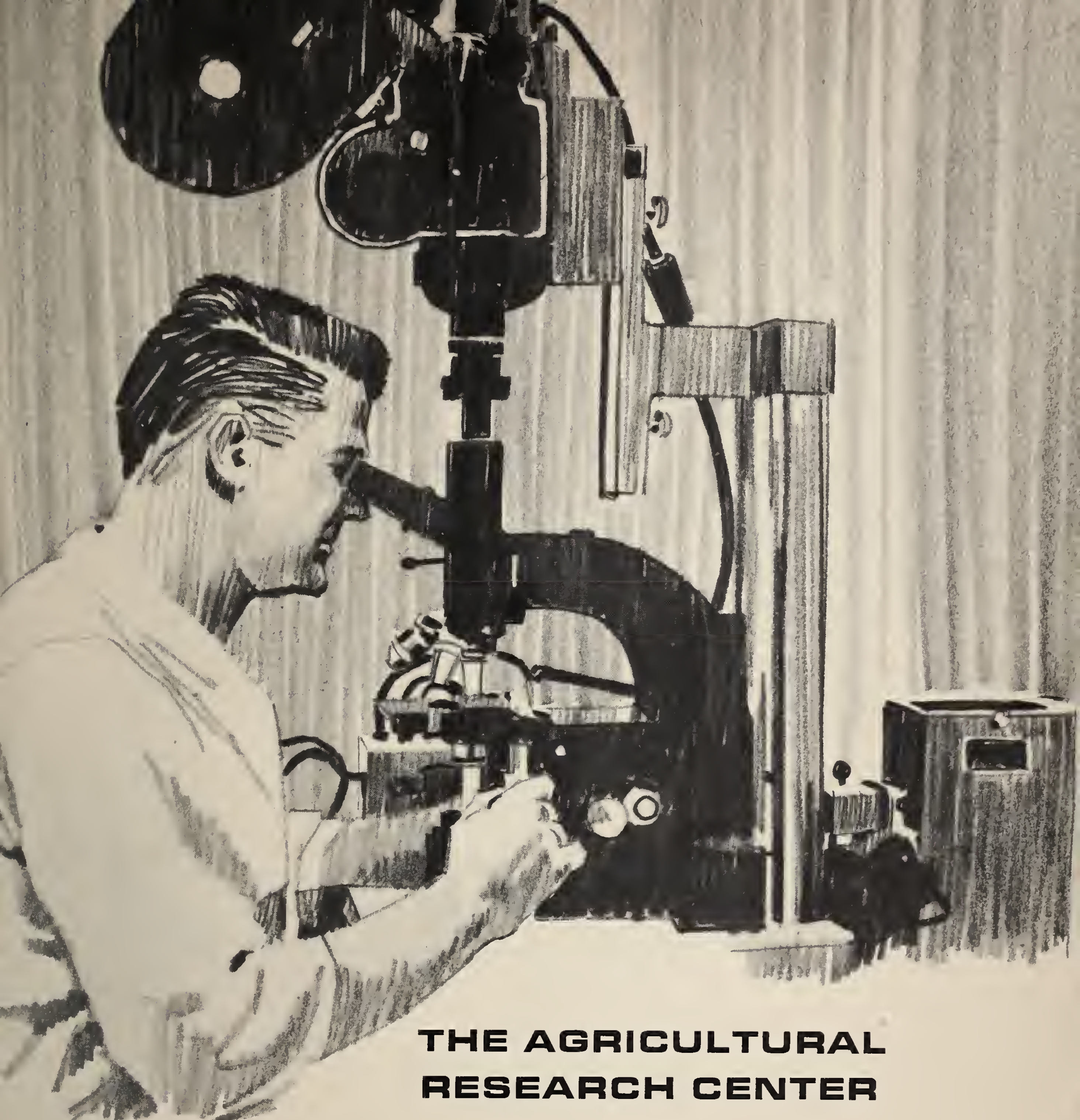

THE AGRICULTURAL RESEARCH CENTER

OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE

AGRICULTURE INFORMATION BULLETIN NO. 189

Agriculture is alive with change. It is a force without bounds...without limits.

Today we have entered a New Era for American agriculture: promising, complicated, difficult.

But as a force without bounds our challenge is more than today — we must always look ahead and ask: What of the future?

It is our responsibility to assure a free agriculture and a market place that provides incentives to produce the abundance we know and expect. We must use scientific resources to provide greater benefits for man...to export technical skills that can free people everywhere from hunger...to wisely use our natural resources...to plan and develop sound communities in the rural countryside — the living room and playground for future Americans.

To accomplish these major missions, we are channeling the great resources of the Department of Agriculture — and its skilled, professional people — into a total, unified, and coordinated effort that replaces and far transcends the "tunnel-visioned" efforts of yesteryear. We are no longer a loose federation of agencies. Today we are a single Department...with mutual motivation and a single set of goals.

We are building toward those goals on the great accomplishments of the past and the challenges of the present...and we are doing it with consistency and determination.

The objectives have been identified and a deliberate course of action set. We call this blueprint for action AGRICULTURE/2000. It combines a look at the hard realities of today with an expression of hope and confidence that the unexcelled potential we possess can help create an ever-brighter, ever-better world.

AGRICULTURE/2000 is a set of mind — a philosophy if you will — that bespeaks the drive and the forward direction of this Department and its people...and emphatically declares that we are working *Today* for a better *Tomorrow*.

AGRICULTURE/2000

Orville L Freeman

Secretary of Agriculture

THE AGRICULTURAL RESEARCH CENTER

OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE

AGRICULTURE INFORMATION BULLETIN NO. 189

CONTENTS

THE AGRICULTURAL RESEARCH CENTER

OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

The Agricultural Research Center, located on 10,000 acres of rolling Maryland countryside north of Washington, D.C., constitutes national headquarters for much of the scientific investigation carried out by the Agricultural Research Service, U.S. Department of Agriculture. Established in 1910, the Center preserves in its groves and fields some of the charm of that predominantly rural era.

But there have been many changes. As our farm technology has developed, research responsibilities have increased. The Agricultural Research Service now conducts much of its research at field stations throughout the country. At these stations, researchers study farm problems of a regional nature. In addition, every State in the Union has its own agricultural experiment station; ARS carries out considerable research in cooperation with these stations.

The principal role of scientists and administrators at the Center is to provide direction and leadership to agricultural research efforts. The research work at the Center deals primarily with problems of national interest. Much of it is basic, or fundamental, research. Many of the ideas conceived and tested at the Center provide the bases for further investigation at regional levels.

The Center's reputation for leadership extends beyond U.S. borders. Each year, thousands of representatives from foreign countries tour the facilities. Services for foreign scientists have been established at the Center. Some of the visiting scientists spend extended periods at the Center conducting research and consulting with resident scientists. World food and population problems dramatize the growing importance of such programs.

Approximately 2,400 persons are employed at the Center. Of these, about half are scientists or technicians; the remainder are clerical, farm, and maintenance workers.

The land area at the Center consists of two separate tracts—one on each side of U.S. Highway 1. On the west side of the highway is the Plant Industry Station, headquarters for the Agricultural Engineering, Crops, Entomology, and Soil and Water Conservation Research Divisions. A larger tract to the east of U.S. 1 contains the headquarters of the Animal Disease and Parasite, Animal Husbandry, and Human Nutrition Research Divisions. Experimental gardens, orchards, pastures, and timber stands are maintained on both tracts.

The Center building complex includes 67 laboratories, 36 greenhouses, and 700 barns and poultry houses as well as storage and maintenance facilities. The animal population at the Center includes some 11,000 laying and breeding fowls, more than 3,000 experimental farm animals, and about 3,500 small animals for use in laboratory tests.

The Center is located at Beltsville, Md.—about 15 miles northeast of Washington and not far from the University of Maryland. Visitors are welcome. Each year about 20,000 persons tour the Center's fields and laboratories. The best way for an individual or small group to visit the Center is by automobile, because many of the buildings are some distance from public transportation. Large groups frequently charter a bus and arrange for a guide (available by appointment from 8 a.m. to 4:30 p.m. Monday through Friday, holidays excepted).

This bulletin is intended as an information guide both to visitors and to interested persons who may be unable to visit the Center. Brief descriptions of each ARS research division are included. Publications containing details of many Center research projects are available from the Office of Information, U.S. Department of Agriculture, Washington, D.C., 20250.

An experimental farm structure. The hyperbolic paraboloidal shape utilizes the strength of thin sheet materials such as steel, aluminum, or plywood.

AGRICULTURAL ENGINEERING

RESEARCH DIVISION

The Agricultural Engineering Research Division conducts research on the machines and structures required by modern agriculture. Experiments are conducted on farm application of electricity, farm building materials, and the mechanical aspects of crop and livestock production at more than 40 locations throughout the United States.

Electricity, already a great labor saver on the farm, is studied in an effort to find additional ways to reduce drudgery and manual labor. Artificial light is important in many farm production problems. Research on light requirements and equipment for stimulating egg production, plant growth, and insect control is being conducted at the Center. Research is also underway to determine functional problems, performance requirements, and effects on livestock and poultry of equipment for year-round ventilation and air conditioning.

Five small experimental dwellings were constructed to determine whether unconventional materials and construction features could be used for farm houses. Expandability and low cost were principal goals in the study. Materials used included lightweight concrete blocks, aluminum, plywood, plastic, and fiberboard. Continuing studies are made of the tightness and livability of the houses.

Basic laboratory research on poultry shelters is aimed at evaluating the effect on bird health of such environmental factors as temperature, humidity, wind, carbon dioxide, and ammonia concentration.

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A pasture renovator designed for seeding legumes directly in bluegrass sod. Starter fertilizer and seeds may be drilled at different depths and spacings.

The Cooperative Farm Building Plan Exchange develops typical plans for improved farm buildings. Working drawings are made available to farmers through the State extension services.

The engineering requirements for improved silage and hay harvesting, processing, storing, and feeding systems are investigated. Studies have been made on the preservation efficiency of field curing, barn drying, dehydration, and ensiling of forage crops.

Agricultural engineers are working on the evaluation of wafering machines, the handling and drying of wafers, and the methods of storing half-dry silage. They are seeking to determine silage densities with radiation techniques and to protect and rehabilitate walls of tower silos. Storage studies continue on techniques for sealing both upright and horizontal silos against air contamination.

Engineers design and build special planting and fertilizing machines and equipment. Field experiments are conducted to determine the most efficient methods

A Engineers designed this Y-shaped light chamber to determine which colors of light will attract insects. Work was done in cooperation with the Entomology Research Division.

B Agricultural engineers, cooperating with the Atomic Energy Commission, are conducting an experiment to see whether dust from radioactive fallout can be plowed under deep enough to make the soil safe for growing crops. The huge plow carves a furrow 42 inches deep.

of planting and fertilizing various crops for all regions of the country. Cooperative studies involving more than 40 field and vegetable crops in more than half the States have helped industry provide better farm machinery.

Current studies involve pasture renovation methods and equipment, new pasture establishment, and seeding and fertilizer placement requirements for both seeded and transplanted vegetables.

Field studies of mechanical methods for removing radioactive contaminants from the soil are also conducted. Conventional and modified farm machines are tested under a wide variety of crop and soil conditions to determine their effectiveness in removing simulated radioactive fallout from the soil surface.

Modern pesticides may constitute a threat to farm water supplies. Engineers are trying to determine the means by which pollutants are reaching the water systems and to develop means by which they may be kept out.

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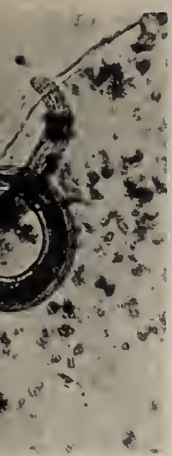
A ▲

ANIMAL DISEASE AND PARASITE RESEARCH DIVISION

The many parasites that attack livestock and poultry are studied at the Center's Parasitological Laboratory, a component of the Animal Disease and Parasite Research Division. Medicinal treatments that have become standard practice throughout most of the world have resulted from this research. Such treatments include the use of phenothiazine for removing worms from horses, cattle, sheep, goats, swine, and poultry.



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Part of the strategy in controlling parasites includes study of the life cycle of the pest. This helps pinpoint the most vulnerable point in the life cycle. Researchers can then work on measures that will break the cycle.

Sometimes the results of research have shown that a combination of control methods can be used against parasites. For example, researchers found that larvae of the stomach worm and other sheep parasites cannot survive more than 4 months under pasture conditions. This finding formed the basis of a control program that included treating the flock with phenothiazine in the fall and spring, then placing the sheep on pasture that had been allowed to lie idle over the winter.

Other studies showed that pigs infected with kidney worms did not pollute their quarters and pastures with parasite eggs until the worms had existed in the pigs for many months. This finding has suggested a possible way of reducing, perhaps even eradicating, these pests by using only young brood sows. This control method is now being tested in the field.

Besides developing control measures, researchers have compiled basic information on the biology of parasites. They have also compiled considerable information on trichinae and other animal parasites that can be transmitted to man.

Two features of the Laboratory that have attracted international attention are the parasite collection and the Index-Catalogue of Medical and Veterinary Zoology. The parasite collection, probably the largest of its kind in existence, permits comparison of known parasite forms with unknown forms under investigation. The Index-Catalogue has been the subject of study by scholars from throughout the world. Both the parasite collection and the Index-Catalogue are useful in developing control programs and preventing exotic pests from entering the country.

The Parasitological Laboratory occupies a 350-acre tract at Beltsville, about one-third of which is used to grow feed for the experimental animals. About 200 buildings are utilized by the Laboratory. These include central laboratory facilities, barns for the large animals, and a number of small isolation quarters designed to accommodate a single animal for critical study. About 800 large animals (cattle, swine, sheep, and horses) and more than 6,000 chickens and turkeys are used each year for experimental purposes. Most of these animals are raised on the premises.

The activities underway at the Laboratory have helped make livestock and poultry production more profitable and have helped insure a supply of wholesome, nutritious meat and poultry products.

A Animal scientists use time-lapse photography to study disease organisms growing and multiplying on cell structure.

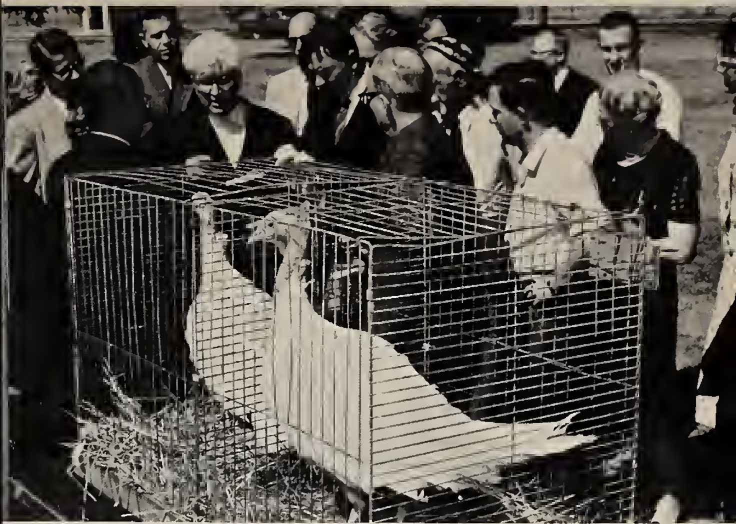
B Worm parasites of cattle can be grown in laboratory cultures that simulate the body chemistry of host animals. This is an important step in parasite research, because it permits scientists to study each growth stage of the parasite. Immunization against parasite infection is one of the foremost goals of the Parasitology Laboratory.

Part of the parasite display at the Parasitology Laboratory.

N-167

ST327-1

The animal's ability to adjust to hot conditions is being studied in this experiment. Researcher checks water balance, skin evaporation, and metabolic heat production.



N-4715

Two of the several parthenogenetic turkeys that have been raised to maturity at the Center. Observing the birds are members of a delegation of Russian farm leaders.

ANIMAL HUSBANDRY RESEARCH DIVISION

Animals and animal products are objects of study by members of the Animal Husbandry Research Division, the oldest of the research units located at Beltsville. Improved production and processing methods are sought for beef cattle, dairy cattle, poultry, sheep, and swine.

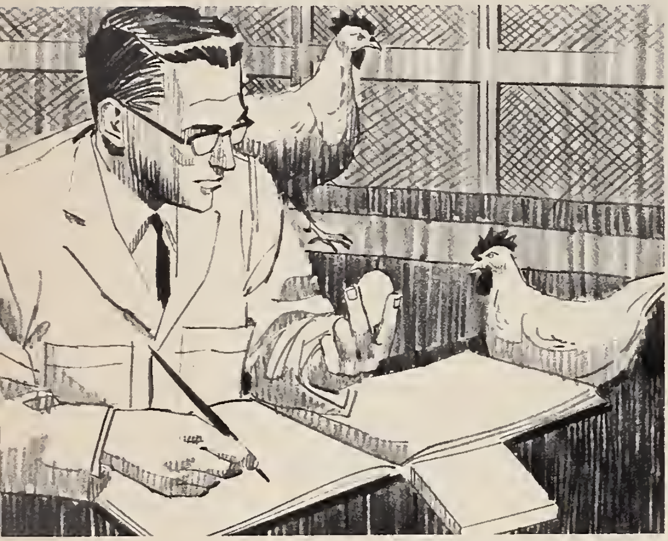
One of the most serious problems of the livestock industry is poor reproductive performance. Estrus, ovulation, conception rates, and embryo survival in beef cattle are studied at the Center. The effects of nutrition and other factors on reproduction are also being investigated.

Cattle can digest nonprotein nitrogen and convert it to protein. This capability is important because of the competition for high-quality protein among humans and animals. Beltsville scientists are experimenting with various nonprotein nitrogen diets to determine which can be utilized most efficiently by beef cattle.

Pesticides have contributed to efficient production of feed crops, but they have also brought the possibility of residue in animal products. To insure healthy

livestock and wholesome meat, researchers are studying the absorption, metabolism, and elimination of pesticides by beef cattle.

The experimental dairy herd at Beltsville consists of 600 animals—including several breeds and assorted crossbreeds. A herd of registered Holstein-Friesians has been maintained since 1918. This herd has contributed much data of importance to the dairy industry. The value of using superior sires has been firmly established.



The first calf born from a synthetic diet. The mother was fed from birth on a synthetic diet containing urea as the only source of dietary nitrogen.

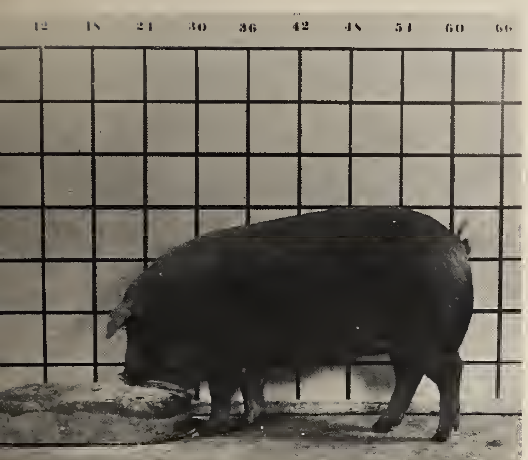
BN-241

The herd is presently being used to compare three systems of mating. One-third of the herd continues under the established practice of using superior, unrelated sires. Another third of the herd is closed, and improvement is being sought through selection and inbreeding. The final third is being bred to superior sires of breeds other than Holsteins.

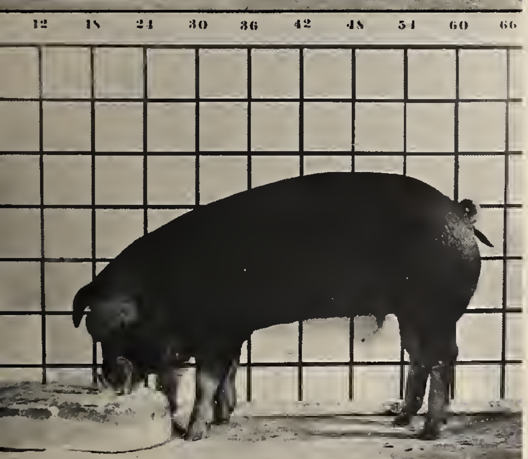
A unique animal metabolism laboratory is used to obtain more accurate information on the nutritional requirements of animals and on the nutritional value of individual feeds and rations. Correlated chemical investigations are being employed to develop more precise ways of analyzing feeds for their nutritional value.

Dairymen have long needed an objective method for determining the genetic makeup of dairy cattle. Researchers at the Center have discovered the genetic mechanism which controls one of the milk proteins. Cattle can now be typed for three distinct milk proteins as well as for red blood cell antigens and serum proteins.

The science of statistics plays an important part in dairy research at the Center. Some 70,000 dairy farmers from throughout the country contribute herd-perfor-



BN-24322



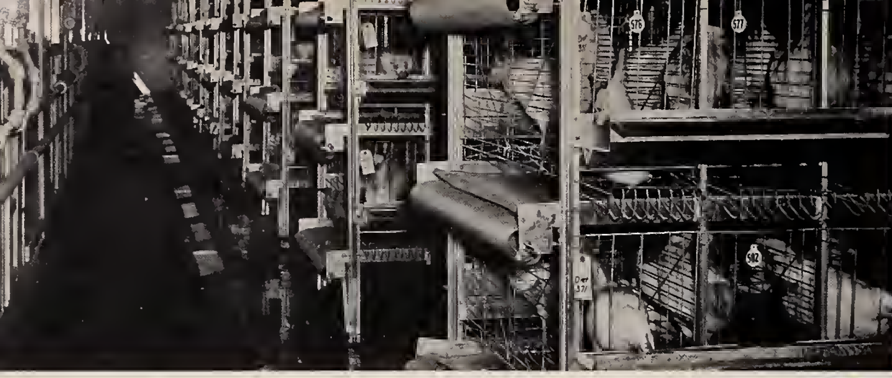
BN-24323

These contrasting photos show how selective breeding can be used to produce desired characteristics. The slender, meat-type hog in the lower photo was developed because of consumer preference for lean pork.

mance information to the Center's dairy herd improvement program. This information, processed by computer and preserved on magnetic tape, helps improve the genetic makeup of the Nation's dairy herd through mass selection.

Poultry experiments are aimed at increasing fundamental knowledge of the domestic fowl and improving efficiency of egg and meat production. Chickens and turkeys of various breeds and crosses are raised for experiments in genetics, physiology, and nutrition. The Japanese quail has also proved a useful laboratory animal for many research projects. The quail matures rapidly, lays many eggs, has a short generation interval, and requires only small amounts of feed for maintenance. Consequently it is an economical source of research information.

274-393 O-67—3



Some of the laying pens used in poultry experiments at the Center.

N-42383

Poultry physiologists are studying the nervous system and hormones which regulate ovulation and egg laying. Examination of the pituitary has uncovered new information regarding the storage area of the hormones that trigger egg laying.

One of the most remarkable discoveries in turkey research has been that of parthenogenesis—reproduction from unfertilized eggs. The cells of parthenogenetic turkeys carry the diploid chromosome number, which appears to be restored during meiotic division. This would mean almost complete homozygosity. Such animals are of special interest and value in connection with tissue transplantation, immunity responses, and related physiological investigations.

Sheep breeding investigations involve a long-term program comparing selected purebred matings of Hampshire, Dorset, Suffolk, and Targhee sheep. Experiments show that crossbreeding increases production of lambs and wool over the average production of parent breeds.

Research is directed toward learning the calorie intake and protein requirements of sheep, and finding new and better methods of evaluating pastures and forages.

Swine breeding experiments at Beltsville are aimed primarily at developing hog types which will furnish the lean cuts of pork that are popular with consumers.

Studies in swine physiology are designed to improve reproductive efficiency and understanding of the biochemical and physiological processes which influence carcass quality. Control of the estrus cycle is under study as a means of developing methods for more extensive use of artificial insemination. Other work involves study of the chemistry and physiology of tissues, organs, glands, and body fluids of different breeds of swine.

A meat quality laboratory is maintained at the Center. Flavor, juiciness, tenderness, and other meat qualities of interest to the consumer are studied here. Trained test panels, and mechanical devices such as the Warner-Bratzler tenderness shear, are employed to develop objective standards of meat quality.

M–1125

Technicians pollinating a peach tree. Controlled pollination is a critical step in the development of new varieties.

CROPS RESEARCH DIVISION

The problems of plant breeding, genetics, disease, growth and development, physiology, crop quality, and production are subjects of study by members of the Crops Research Division. The Division is composed of 9 branches: Cereal crops, cotton and cordage fibers, forage and range, fruit and nut crops, oilseed and industrial crops, tobacco and sugar crops, vegetables and ornamentals, crops protection, and new crops. Work is conducted in laboratories, greenhouses, and field plots.

Cereal research projects include breeding of corn, barley, wheat, oats, and rice, and investigations of rusts, mildews, smuts, viruses, and other cereal diseases. A seed collection including varieties from throughout the world is maintained. Seeds from this collection are used to develop improved varieties for use in this country.

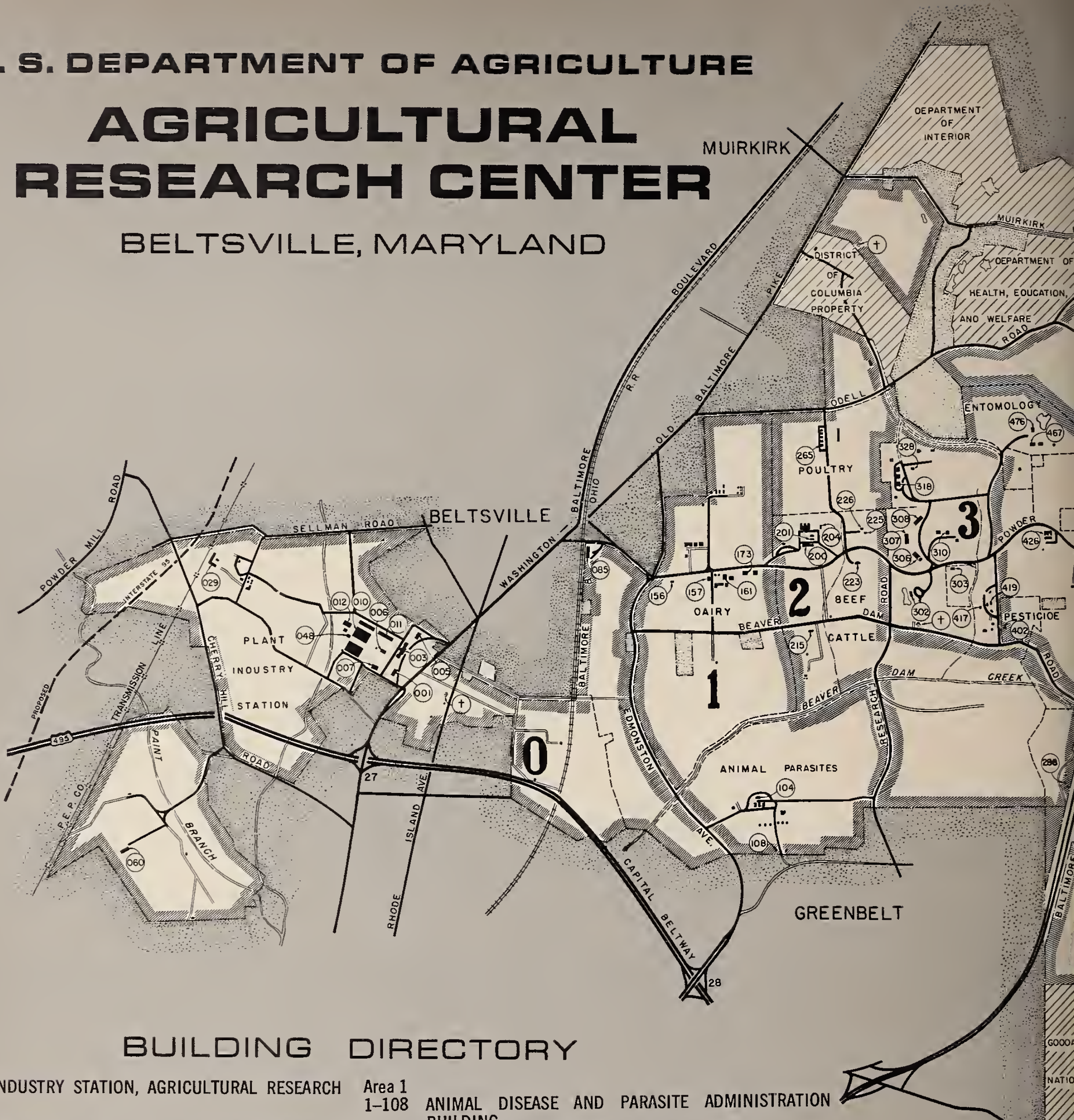
Cotton research at Beltsville, conducted primarily in cooperation with State experiment stations in the South, is aimed at discovering the causes of fiber deterioration prior to harvesting.

Forage and range research involves breeding, stand establishment, and management studies of grasses and legumes for pasture, hay, and turf. A specific example concerns the role of light in forage production. Initial studies indicate that foliage density has an effect on the efficiency with which available light is used. Stand density, clipping, and growth rate studies are underway to determine how to manage pastures for more efficient use of light.

U. S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH CENTER

BELTSVILLE, MARYLAND



BUILDING DIRECTORY

Area 0 PLANT INDUSTRY STATION, AGRICULTURAL RESEARCH CENTER

- 0–003 ADMINISTRATION BUILDING (Market Quality Research; Plant Pest Control; Crops; Library; Soil and Water Conservation; Radiological Safety Office; Visitors' Service; Travel Office; Division of Operations)
- 0–060 FARM EQUIPMENT STORAGE AND SUPPLIES
- 0–029 FARM SERVICE FOREMAN, DIVISION OF OPERATIONS
- 0–085 GRANARY (Division of Operations)
- 0–010 GREENHOUSE, RANGE 2 (Cafeteria)
- 0–011 GREENHOUSE, RANGE 1 (Forest Physiology Laboratory)
- 0–005 NORTH BUILDING (Agricultural Engineering; Biometrical Services; Crops; Entomology)
- 0–012 PHOTOGRAPHIC LABORATORY (Information Division)
- 0–007 SOILS BUILDING (Soil and Water Conservation; Soil Conservation Service)
- 0–001 SOUTH BUILDING (Crops)
- 0–048 STORED PRODUCTS INSECTS BUILDING (Market Quality Research)
- 0–006 WEST BUILDING (Crops; Market Quality Research)

Area 1

- 1–108 ANIMAL DISEASE AND PARASITE ADMINISTRATION BUILDING
- 1–104 BELTSVILLE PARASITOLOGICAL LABORATORY
- 1–161 DAIRY ADMINISTRATION BUILDING
- 1–173 DAIRY BREEDING AND MANAGEMENT BUILDING
- 1–157 DAIRY PRODUCTS LABORATORY (Isotope and Cheese Investigations, Eastern Utilization)
- 1–156 U.S. PARK POLICE SUBSTATION

Area 2

- 2–200 ANIMAL HUSBANDRY ADMINISTRATION BUILDING (Eastern Utilization)
- 2–223 BEEF-CATTLE BARN
- 2–226 BIOMETRICS LABORATORY
- 2–225 PESTICIDES REGULATION
- 2–288 PESTICIDES REGULATION
- 2–204 MEATS LABORATORY
- 2–265 POULTRY ADMINISTRATION BUILDING
- 2–215 SHEEP BREEDING BARN
- 2–201 SMALL-ANIMAL BUILDING

Area 3

- 3–303 AGRICULTURAL ENG
- 3–307 CENTER LABORATOR Headquarters Visitor Use)
- 3–328 FOOD AND DRUG A
- 3–302 LOG LODGE (Cafete
- 3–318 MEAT AND POULTR
- 3–308 NORTH LABORATOR sumer-Use)
- 3–306 SOUTH LABORATORY Marketing Service, P Research)
- 3–310 WATER-TREATMENT

Area 6
6–604 AIRPLANE HANGAR (Methods Improvement Operations, Plant Pest Control)
6–606 AIRPLANE HANGAR (Forest Insects)
6–632 FOREST DISEASE LABORATORY

ABORATORY
of Operations; Clothing;
Nutrition and Consumer-

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y; Grain, Consumer and
gulation, Market Quality

Area 4
4–445 AUTOMOTIVE SHOPS
4–476 ENTOMOLOGY LABORATORY "A" (Insect Pathology)
4–467 ENTOMOLOGY LABORATORY "C" (Insect Physiology, Entomology; Forest Insect Laboratory, Forest Service)
4–426 MECHANICAL SHOPS
4–417 MINERAL DEPOSITS BUILDING (Geological Survey)
4–402 PESTICIDES REGULATORY TESTING BUILDING
4–419 RADIO LABORATORY (Forest Service)
4–434 SHEEP NUTRITION BARN

Area 5
5–516 BEEF CATTLE
5–536 SWINE BARN

OTHER GOVERNMENT AGENCIES

Area 5 GODDARD SPACE FLIGHT CENTER (National Aeronautics and Space Administration)
RADIO STATION WWV (U.S. Department of Commerce)

Area 6 U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

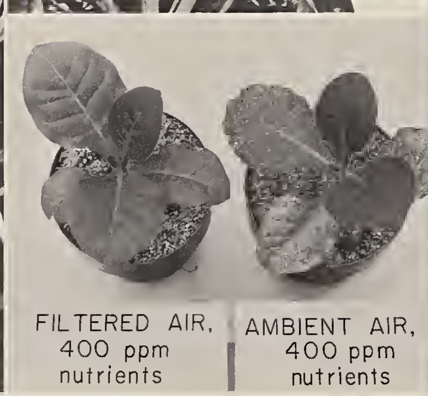
Area 7 PATUXENT WILDLIFE RESEARCH CENTER (U.S. Department of the Interior)

Research on fruit and nut crops is carried on in greenhouses and on more than 75 acres of orchards and vineyards. Research is aimed at development of improved varieties, new methods of production, disease control, and basic knowledge of plant growth. In spring, the blooming hillside orchards provide a colorful backdrop for the Beltsville research facilities. Kinds of fruit grown for study include apples, peaches, pears, grapes, strawberries, blueberries, raspberries, and blackberries. Among the nut crops are Chinese chestnuts, Persian walnuts, black walnuts, and filberts.

B

BN-22775

D



A

M-4067

C

E

A Collecting spores of the fungus that causes stem rust of wheat.

B Plant scientists have learned how to change the natural growth responses of plants. Here, a pineapple plant is treated with a chemical that will force it to bear fruit prematurely

C Crops researchers are studying the effects of air pollution on plant life. These two tobacco plants were grown under identical conditions, but the one on the right received normal air, the one on the left air that had been filtered through activated charcoal.

D Selectivity is the key to good chemical weed control. In this test plot, the center strip was treated with a chemical that killed most weeds but allowed many of the crops to grow. The strip at right is less effective; more weeds survive, more crops are killed. At left is untreated soil

E An experimental planting of mushrooms. Mushroom research at the Center includes methods of controlling diseases, improvement of composts, and basic studies on genetic and strain improvement.

Oilseed and industrial crops researchers study the genetics, breeding, and diseases of soybean, peanut, safflower, and castorbean and other industrial crops. Investigations on minor crops, such as hop, mint, canaigre, sunflower, and guar, are also conducted.

More than 200 varieties of imported sugarcane are maintained in a quarantine greenhouse and studied by sugar crops researchers. Sugarcane and sugarbeet stock is distributed to field stations in the United States and other countries for further breeding experiments.

Vegetable and ornamental researchers study control of soilborne diseases, the development of disease- and insect-resistant varieties, the genetics and breeding of improved varieties of vegetables and ornamentals, and the physiology of ornamentals.

M-5054

Crops protection researchers work on problems of weed growth and control, and develop methods of forecasting plant disease epidemics. The physiological actions of herbicides are studied. Chemical weed control studies include an evaluation of preplanting, preemergence, and postemergence applications for field and horticultural crops. Study of the chemical behavior of herbicides and other pesticides in the soil is a major project.

Researchers working on new crops assess the needs of industry and agriculture for new raw materials that can be supplied by plants. Plant resources throughout the world are surveyed. Promising new plants are collected, evaluated, tested, and perpetuated.

Other components of the Crops Research Division include the Pioneering Research Laboratories and, in Washington, D.C., the National Arboretum. At the Pioneering Laboratories, basic studies are conducted on light, temperature, viruses, and growth-regulating substances. The Arboretum is noted for its excellent collections of azaleas, camellias, hollies, crab apples, dogwoods, conifers, and other woody ornamentals.

BN-20908

A miniature tourniquet is applied to a nerve cord in a cockroach. The experiment is part of a basic study of the complex relationnships of brain, nervous system, endocrine system, and reproductive organs in insects.

ENTOMOLOGY RESEARCH DIVISION

Harmful and beneficial insects receive the investigative attention of researchers in the Entomology Research Division. Approximately 15 percent of the Division's work is conducted at Beltsville. The remainder is done in field laboratories scattered throughout the United States, Puerto Rico, and seven foreign countries.

Entomological research includes efforts to find safe, effective insecticides and methods of applying them. Special effort is devoted to research on selective materials that will reduce residue hazards and control insects that have become resistant to insecticides.

Methods have been devised to analyze and determine insecticide residues on crops and in livestock products. The results of the analyses are used to adjust insecticide applications so that residues will not exceed legal tolerance limits.

Chemicals produced by plants are tested to determine the value of these natural products in insect control. Substances occurring in insects themselves are also studied as a possible source of selective attractant.

The principle of applying insecticides by means of the aerosol bomb was developed by scientists at the Center during World War II. Aerosols have proven

to be of immense commercial value as dispensers of a variety of products. Research continues in an effort to improve aerosol formulations and equipment.

Thousands of test insects, such as mosquitoes, flies, and cockroaches, are reared under controlled conditions. Special strains are perpetuated and exchanged with other laboratories so that results of tests can be compared.

Insect contamination in processed fruits and vegetables causes heavy losses to processors and growers. Part of the research work on fruits and vegetables involves prevention of such contamination by controlling the insects in the field. Other investigations are concerned with insecticide residues on vegetable crops. Samples of the treated crops are harvested at various intervals after the application of insecticides and taken to the laboratory for chemical analysis. The waiting periods necessary between last application of an insecticide and harvest of the crop are thus determined.

Some strains of spider mites that attack fruits and vegetables have become highly resistant to miticides. When resistant mites mate with nonresistant mites, the offspring are resistant. Tests are underway to find new chemicals to use as old ones become ineffective.

The alfalfa weevil is under study by the Entomology Research Division. Control of the weevil is sought through the use of safe, effective insecticides. Development of weevil-resistant alfalfa varieties is also undertaken in cooperation with the Crops Research Division.

A

Applying aerosol insecticide in one of the Center greenhouses.

B

An apiculturist records data on bee experiments. In background are some of the glass hives used in studies of diseases and pests of honey bees at the Center.

A TC-5459

B ST-326-10

BN-20514

Experimental insects are released during study on nonchemical control of houseflies. Good control, less dependence on toxic insecticides are aims of this and many other entomology studies.

Ticks carry a number of diseases which affect livestock. Entomologists are trying to determine the role that ticks play in the transmission of diseases such as anaplasmosis, a serious disease of cattle, and equine piroplasmosis, a newly introduced disease that affects horses.

The Entomology Research Division develops practical and economical methods for controlling diseases and pests of the honey bee, and provides a diagnostic service for beekeepers and State apiary inspectors. Experimental insecticides are screened for their relative toxicity to bees. A colony of honey bees is maintained in a glass observation hive for the benefit of visitors to the Center. The library on bee culture (a branch of the National Agricultural Library) is one of the world's most extensive on the subject.

Basic studies to develop facts and background information on insects are carried on in two Pioneering Research Laboratories—the Insect Physiology Laboratory and the Insect Pathology Laboratory. In the Insect Physiology Laboratory, researchers study insect growth, metamorphosis, reproduction, and other factors that might furnish clues to effective control of insect pests, and conduct basic research on the biochemistry and physiology of insects. Researchers in the Insect Pathology Laboratory study the action and growth requirements of pathogenic viruses, bacteria, fungi, protozoa, and nematodes that attack insects. Methods of using these organisms to control harmful insects are also investigated.

▲A

N–50381

▲B

A Measuring the uptake of radioactive phosphorus in barley roots. Entry of nutrient elements into plant roots is one of the most basic—and least understood—functions of plant life.

B One of the mysteries of plant life: One of these identical soybean plants can utilize iron from the soil, the other (right) cannot. Soil scientists are trying to determine why.

SOIL AND WATER CONSERVATION RESEARCH DIVISION

Most of the work of the Soil and Water Conservation Research Division is done at field stations throughout the country, in cooperation with State experiment stations and other agencies. Facilities at Beltsville include the Soils Laboratory, the Mineral Nutrition Pioneering Research Laboratory, and the Hydrograph Laboratory.

The Soils Laboratory serves as a national center for fundamental research on soil science and soil-plant relationships. Soil chemists are investigating the mecha-

nisms by which nutrient elements and other applied chemicals are retained by the soil. Research on soil-plant relationships includes studies of the nutrient requirements of plants, the mechanics of nutrient absorption, and toxicities of essential and nonessential elements.

Plant response to lime is related to aluminum toxicity in the soil. All of these barley plants were grown in Bladen soil—a soil containing toxic aluminum. The plants at right received enough lime to counteract the effects of the aluminum.

Work in soil physics involves study of such processes as mass flow and diffusion of ionic and molecular substances. Current emphasis is placed on determining the influence of temperature on plant behavior and on water and nutrient movement in the soils.

Soil microbiologists are studying transformation and maintenance of organic matter and nitrogen in soils. The ecology of the legume bacteria, improvement of inoculant strains, and improved methods of inoculation are being studied. Other current work includes study of the role of soil microbes in plant nutrition, root growth, soil structure, and pesticide decomposition.

At the Mineral Nutrition Pioneering Research Laboratory, scientists are studying the processes by which plants take up nutrients; how the nutrients function in plants; and how mineral nutrition is related to the environment of the plant and the complex process of growth. The purpose of the laboratory is to develop a better understanding of life processes in plants, especially the role of mineral nutrients. Laboratory findings provide a scientific basis for solving the practical problems of soil fertility and crop production.

ST-520-6

A researcher refers to a U.S. watershed map that shows areas where soil samples have been collected. This, in turn, is related to major land resources which are shown on the smaller map.

In the Hydrograph Laboratory, data analyses are conducted to test new ideas in watershed engineering. Information on rainfall, geology, soils, vegetation, and hydrology is assembled. The laboratory maintains working relations with various conservation agencies and institutions throughout the Nation.

Work at this national laboratory is broken down into five major categories: (1) Meteorology and climatology; (2) surface water dynamics; (3) hydrologic evaluation of watershed soils and vegetation; (4) hydrogeology, and (5) the hydrologic performance of watersheds.

The laboratory staff makes extensive use of computer systems, without which the more complex data analysis projects would be virtually impossible.

BN-24194
A biologist examines body tissue through an electron microscope to determine the effect of diet on tissue.

NUTRITION AND CONSUMER USE RESEARCH

Careful study of factors that contribute to improved nutritional well-being and better living for the Nation's families is the responsibility of the Nutrition and Consumer Use Research Program. Two divisions participate in the program: The Human Nutrition Research Division, located at the Center, and the consumer and Food Economics Research Division, located in nearby Hyattsville. In addition, much work is carried on either cooperatively or by research contract or grant in many of the States.

Members of the Human Nutrition Research Division study the composition, quality, and metabolic use of foods. Concern about the use of pesticides has led to

studies to determine whether chemicals used in agriculture have any effect on the nutritive content, acceptability, or biological value of foods.

The possible relationship of dietary fat to heart disease has prompted studies on fatty acid content of foods, and the influence of processing and preparation on fatty acid content. Dietary fats are studied further in experiments with laboratory animals. The animals are fed diets containing different kinds and amounts of fat, or fat altered by processing or cooking. Effects on growth, reproduction, body composition, and longevity are observed. The kind of carbohydrates consumed has been shown to affect deposition of fat in the body and tissues of animals, and the cholesterol content of the serum and liver. Physiologists, biochemists, and pathologists are studying changes in animal tissues that can be attributed to diet as well as the implications of these changes to our well-being.

The nutritional requirements and metabolic responses of people are being studied by feeding standardized diets to human subjects of various age groups. Analyses of food, blood serum, and excretion products give information to nutritionists about the body's use of and need for amino acids, lipids, vitamins, and minerals. Different combinations of nutrients are tried in experimental diets; for

A

B

BN-23766

A A chemist draws off one fraction of a food sample from a column containing an ion exchange resin during a test for vitamin B^6.

B Preparing diets for a controlled feeding study. Fifteen college girls volunteered for this experiment, which compared meals of different size and frequency but similar caloric content.

Filtering samples for mineral analysis in human metabolism studies.

instance, one test group eating a diet in which the carbohydrate is furnished by cereal starch alone is being compared with a group eating a similar diet in which other types of carbohydrates are incorporated.

Nutrition research also involves chemical analyses and assessment of food constituents. Protein and amino acids have been determined in a wide variety of foods. Many of the water-soluble vitamins have been determined and the results published in handbooks; research is continuing to determine individual vitamin B_6 components in foods. Thin layer chromatography is being used to separate and identify specific sugars to help scientists understand the nutritional role of the carbohydrates. Sensitive electronic equipment is used to detect the often-minute amounts of minerals in foods.

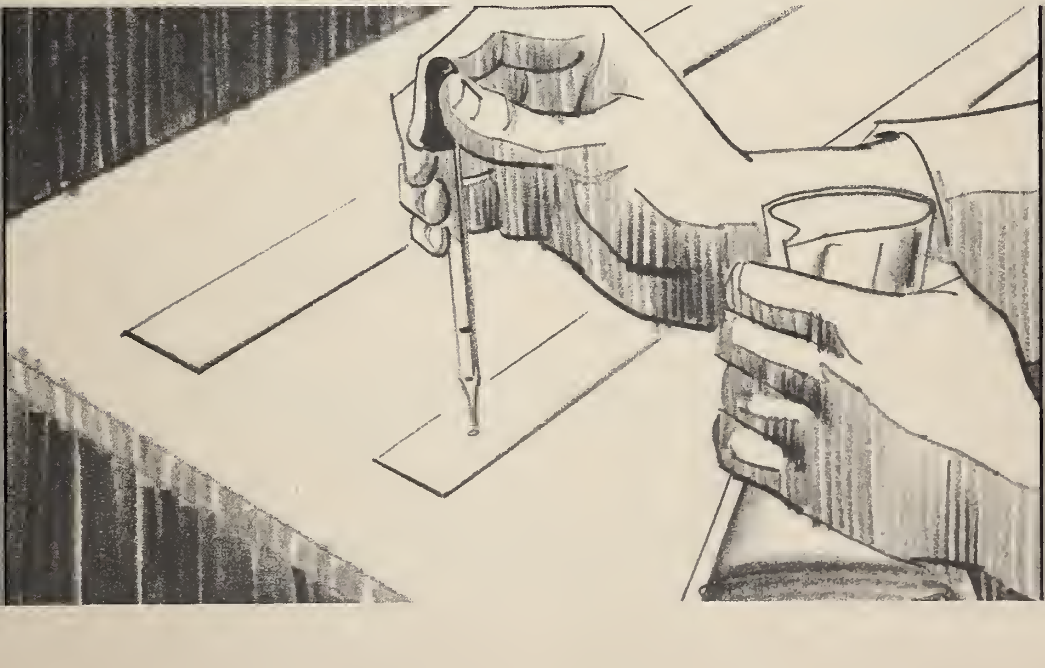
Chemists at the Center are analyzing wheat products from markets in different regions of the country to determine effects of milling processes and food formulation practices on mineral content, individual carbohydrates, tocopherols, and other nutrients.

Food specialists study basic principles of food preparation and their effects on the quality and wholesomeness of different foods. Taste panels score foods for acceptability, using color, texture, tenderness, and flavor as criteria. These ratings are correlated with chemical, physical, and bacteriological laboratory tests for quality.

The Human Nutrition Research Division contributes to the National School Lunch Program by developing and evaluating recipes for quantity service. School cooks and supervisors are given food planning and buying guides.

Nutritionists also cooperate with UNICEF, the World Health Organization, the Food and Agriculture Organization, and other agencies in the development of new food products from high-protein oilseeds. These new food products are needed in countries where animal protein is in short supply.

Although the Consumer and Food Economics Research Division is not located at the Center, its researchers work in close cooperation with the scientists at Beltsville. The Division conducts extensive surveys of the food buying and eating habits of the Nation's families. Estimates of the nutritive content of food eaten are then calculated and the data tabulated separately for different population groups. This information is helpful in planning food production, marketing, and education programs.



N-41254

▲ A

MARKET QUALITY

RESEARCH

The Market Quality Research Division conducts part of its research at Beltsville. This work, done by physical and biological scientists, is designed to evaluate, maintain, and improve the market quality of agricultural products from farm to consumer.

The Division's Horticultural Crops Branch conducts research at Beltsville on how to protect and improve the quality of fruits and vegetables so the consumers

N–24922

B

A A marketing researcher uses a quality measuring machine to check for internal defects in potatoes.

B Testing the effects of packaging and moisture on peppers.

can buy good quality, nutritious products, and farmers will receive top prices for their products. Scientists of the Branch study the correct temperature, humidity, and atmosphere to prevent decay, overripeness, and other deterioration, and determine the kind of storage, transportation, and packaging that will provide the optimum conditions for long market life.

Research in the Horticultural Crops Branch has shown how to extend the storage and market life of Golden Delicious apples by use of polyethylene box liners; how to treat peaches and other fruits with hot water to prevent decay; the proper temperatures for storing, transporting, and ripening of tomatoes; and treatments to keep potatoes from sprouting while in storage.

The Field Crops and Animal Products Branch conducts research at Beltsville on evaluating and preserving the quality of grains, seeds, dairy products, poultry, and livestock. They devise chemical and physical tests to measure quality; develop instruments and methods for sampling; and study the effect of different kinds and intensities of artificial light on inspection of agricultural products. Scientists of this Branch developed a quick practical sedimentation test to show the amount of smut in wheat samples, determined the kind of lighting that is best for inspecting grain and poultry, and designed and tested a pneumatic probe for sampling grain that is stored in deep bins.

The Market Quality Research Division also maintains an Instrumentation Research Laboratory and a Pioneering Research Laboratory at Beltsville.

The assignment of the Instrumentation Research Laboratory is to develop instruments that will measure quality objectively without destroying the product.

A horticulturist analyzes the gas content of a box of apples packed in polyethelene liner.

N-24931

Instruments are designed, built, and tested by marketing researchers at the Plant Industry Station and other locations.

A new electronic bloodspot detector designed at the laboratory is now in commercial use in egg-grading plants. Tomato growers are getting a better measure of juice color because of the colorimeter developed by the laboratory. Peanut growers are benefiting from a wide variety of instruments, one of which automatically draws off a more accurate test sample than was heretofore possible.

New devices that measure the amount of hidden insect infestation in grain, detect water core in apples, and measure mold damage in corn are currently under test. Light penetration devices that detect hollow heart and black spot in potatoes and judge the maturity of apples have been developed at the Instrumentation Research Laboratory.

The Pioneering Research Laboratory does basic research on what happens within the cells of living things such as fruits and vegetables after they are harvested.

For example, scientists have long known that a gas called ethylene has much to do with the ripening of many fruits and vegetables. Some fruits and vegetables give off this gas in extremely minute amounts. What produces the gas within the product is still not known, but scientists have now identified one ethylene-producing enzyme and answered one more question about the life cycle of fruits and vegetables.

In addition to the research at Beltsville, the Market Quality Research Division conducts studies at 20 field laboratories which are located in various parts of the country. Six of the field laboratories belong to the Stored-Product Insects Branch. Scientists in these laboratories develop and test insect resistant packages, new insecticides, and nonchemical methods to control insects in food products.

UTILIZATION

RESEARCH

The Eastern Utilization Research and Development Division has headquarters at Wyndmoor, Pa., but maintains laboratories at Beltsville for research on the chemistry and microbiology of meat, cheese, and milk.

Meat research facilities include laboratories for chemical and microbiological research, and pilot-plant equipment for freezing, curing, and processing meat. Meat technologists separate meat into the several constituents that influence flavor and aroma. They study meat proteins and protein characteristics. Fat oxidation, meat rancidity, and the relation of bacteria to meat flavor are studied. A collection of cultures of micro-organisms is maintained.

Experimental cheese is made on pilot-plant scale. All the steps in cheesemaking—curdling, cooking, pressing the curd, and curing—are carried on with commercial or experimental equipment. Effects of different kinds and combinations of bacterial starters and enzymes on quality and flavor of cheddar cheese are studied.

Pilot-plant research on manufacture of butter oil is carried out, and novel means of removing foreign and feed flavors are sought.

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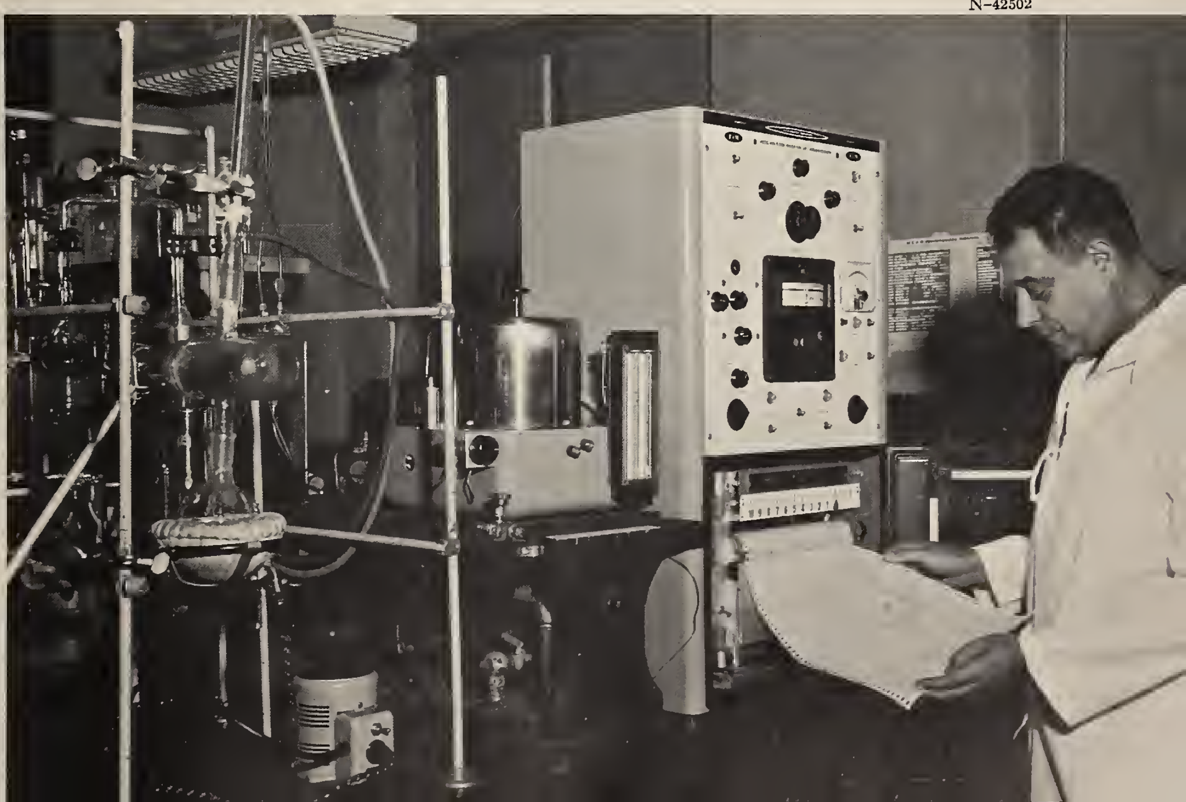

utilization researcher
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UNITED STATES DEPARTMENT OF AGRICULTURE

1862 1889

AGRICULTURE IS THE FOUNDATION OF MANUFACTURE AND COMMERCE

science and CONSUMERS

U.S. DEPARTMENT OF AGRICULTURE AGRICULTURE INFORMATION BULLETIN NO. 322

science and CONSUMERS

the story of how agricultural research serves you

Strawberries in December. Greener lawns. Cottons that never need pressing. Weedless gardens and wormless apples. The near conquest of undulant fever. The greatest outpouring of good nourishing food in the history of the world.

With these and thousands of other research developments, many so familiar that we take them for granted, agricultural science is sustaining and changing the life of every American consumer. It also is pointing the way to changing the world—improving the lives of millions of hungry and needy people.

Agricultural science is practiced in America by men and women with a variety of disciplines and skills. They search for better seeds, for meatier animals. They try to find out what makes plants and animals grow. They work on new ways to kill the weeds and insects that compete for our food and fiber. They look for better ways to harvest crops and to get them to market in top condition. They take crops apart to create new products; they look for new uses for our agricultural abundance.

The results of their research are not buried in a book of mathematical equations—or rolled away on microfilm in a basement vault. You can see them for yourself in every American supermarket, in every kitchen, clothes closet, and medicine chest, in our stronger and healthier children.

Keeping the Cupboard Full

Scientists in agriculture work with nature itself: air, water, land, fibers, plants, and animals—everything that sustains life.

Mostly they are concerned with producing enough food of the right kind—for now and for 25 or 50 years from now. Americans enjoy the greatest volume and variety of good food of any people in the world. Agricultural scientists and informed farmers intend to keep it that way.

When a farm crop gets into trouble with insects, disease, or drought, scientists team up to solve the problem. If an agricultural product doesn't taste right, or sell in the consumer market, scientists find out why not.

The end result—improved and tailored to your needs—may be a juicier steak; a sweeter ear of corn; a potato with more vitamin C; milk with less fat; or a fresher, plumper blueberry.

A case in point. Not many years ago, consumers were demanding pork with less fat and more lean. It took nearly 20 years of selecting, breeding, and experimentation to produce the meat-type hog. That's the kind of hog that provides the lean bacon and choice ham you enjoy today.

Scientists started with several hogs of the Danish-Landrace breed, already known for efficient meat production. They crossed this breed with several domestic hogs—changed their genetics—and came up with animals that grow leaner loins, hams, and bacon. The improved strains also produce more pigs than ordinary farm hogs. And the young pigs grow faster and take less feed to reach market weight.

Now, animal scientists are developing a new strain of sheep, appropriately named Morlam. Ewes of this strain produce an extra crop of lambs every 2 years—and more choice leg of lamb for you.

Fresher Foods, Moving More Efficiently

Keeping our cupboards full is only part of this success story. Just as amazing is the marketing system that moves food to consumers.

You can choose meals from foods grown in each of our 50 States. This didn't just happen. Such a highly mobile food industry involves many steps in transporting . . . cleaning . . . trimming . . . preparing . . . packaging . . . storing . . . protecting and measuring quality . . . and finally displaying for sale to the consumer.

USDA marketing and transportation experts are on the job all along the marketing network—stepping up efficiency and cutting costs. Their big thrust: To get the widest distribution of high-quality foods at the lowest possible cost.

The payoff? If no innovations and improvements had been made in marketing and handling our food supply during the past 15 years, the food marketing bill in this country would be about $9 billion greater a year than it is now.

Low-Cost Poultry

Chicken and turkey cost less per edible pound today than they did in World War I when they were marketed live! Our poultry now comes ready-to-cook, chilled or frozen—cut up or whole—stuffed or deboned—as you like it.

Scientific production of meatier, more compact birds in less time and at lower cost sets the stage for this success story. Advances in handling and marketing poultry—from research—climax it.

Highly mechanized slaughtering plants, located where poultry is grown, turn out 1,000 birds per hour. Streamlined methods for chilling, weighing, inspecting, cutting up, and packing move poultry fast. Savings in shipping and labor costs keep retail prices down. Proper temperatures in transit, storage, and retail freezer cabinets maintain the tenderness and flavor that make poultry so good to eat.

You—and consumers everywhere—are the winner.

Big, Bigger Boxes

The "Big Box"—an abbreviation of the high-sounding term "containerization"—has a lot to do with food marketing in this country—and abroad. The big advantage of the Big Box is that a number of individual packages or boxes can be put in it and handled and transported as a single unit.

Research workers in USDA have been working with the Big Box for a number of years. They set up specifications, improve insulation and refrigeration, make test runs and follow them up.

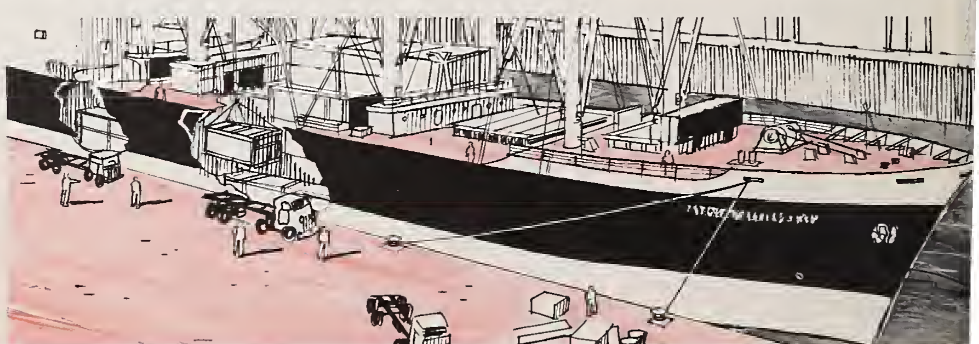
You've seen the Big Box in action many times—on a flat car as it speeds along a railroad track or on a truck chassis delivering produce to a supermarket.

The Big Box on rails—piggybacking—carried more than 50,000 carlots of farm produce across this country in 1966. It's the fastest growing segment of rail transport.

Now, the Big Box is off the ground and on ships helping increase farm exports. Foreign buyers want fruits, vegetables, meats, and poultry shipped via the Big Box. Produce arrives in better condition, at lower cost. And there's little chance for pilfering.

Cargo ships regularly carry van containers between the U.S. mainland and Hawaii, Puerto Rico, and Alaska as well as to all our coasts. They also sail from our shores to Central and South America and to Europe. The Orient is next.

And the Big Box is going aloft! Mammoth transport planes are on the drawing boards to carry



Many farm exports—meats, poultry, fruits, and vegetables—now go to foreign markets in Big Boxes. Specially designed booms lift the huge refrigerated containers from their truck chassis and lower them into the holds of ocean liners, as shown here. USDA research helped develop the Big Box, already widely used in food transport throughout the United States.

these vast containers, and pilot studies and experiments are in progress.

Market Planning That Saves Millions

New wholesale food distribution centers, planned by USDA marketing and transportation specialists, gradually are replacing outmoded marketing facilities in America's cities.

At the request of city governments and civic agencies, complete plans have been developed for 60 major cities. Thirty of these gigantic food distribution centers already have been built. More are on the way.

Centralization of a city's marketing facilities into one strategically located complex moves food faster, costs less. For example, Philadelphia's new market, built from USDA plans, saves more than $7 million a year in food handling costs.

The Nation's largest and most modern wholesale meat market was built in Boston at a cost of $13 million. Again, USDA planned it.

New York City is rebuilding its marketing facilities from plans developed by agricultural research. Vegetable and fruit sections are now completed. Total cost for the new center is approximately $70 million; net annual savings in food handling costs, approximately $25 million.

Now, USDA research studies and plans for Chicago's 435-acre wholesale market are complete. Construction of this new facility would result in an annual savings of $19 million in handling and marketing food products in the greater Chicago area.

New wholesale centers in Atlanta, Houston, St. Louis, San Francisco, San Antonio, Birmingham, and Kansas City are among those built from USDA plans and recommendations.

Each plan includes building designs, site layouts, and ample parking and service areas. The plans estimate construction costs and savings in distribution costs that would result from a centralized food terminal.

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Before and after views of the New York City fruit and vegetable market dramatize changes taking place in terminal marketing facilities. The old Washington Street market (right) with its outmoded buildings and narrow cobblestone trafficway was totally inadequate to handle fresh produce for metropolitan New York. The new terminal market (below) now in operation on a 126-acre site on Hunts Point, the Bronx, was built from plans developed by agricultural research workers.

Foods That Help You Cook

Agricultural scientists also make food quick and easy to cook. Scores of today's timesaving convenience foods originated in agricultural laboratories.

Here, for example, is how agricultural engineers put the "puff" in puffed carrots—a process that makes it possible to cook dehydrated carrots in 5 or 6 minutes.

Ready—aim—puff! Pieces of partially dried carrots actually explode from a high-pressure puffing gun when they are exposed to the lower atmospheric pressure outside. Explosion puffing creates tiny pores in the pieces that hasten drying.

Puffed carrots taste just like fresh cooked after 5 or 6 minutes cooking. You don't have to spend 25 to 30 minutes washing, scraping, and cooking them the old way.

The process also works for blueberries, potatoes, beets, and sweetpotatoes. The latest byproduct of explosion puffing is instant applesauce. Dehydrated apple pieces convert to applesauce by adding hot water. The sauce has genuine apple flavor—even the "grain" of fresh applesauce.

Puffed carrots are on the market now; instant applesauce will be soon.

Leisure for Sale

Time saved preparing meals means leisure—sometimes money—to employed homemakers and mothers. They buy a good-tasting convenience food whenever one appears at the supermarket, especially if the price is right! The price often is right because competition between food processors in this country is keen.

Recently food scientists at Beltsville, Maryland, made a time and cost study comparing a variety of dishes prepared from processed and fresh potatoes.

They concluded: Women who value their time at 50 cents an hour or more will be money ahead using processed potatoes instead of fresh ones. Preparing potato puffs, for example, took only 17 minutes. Starting with unpeeled potatoes, the job took 86 minutes.

Processed potatoes were made possible by agricultural research. Whole-egg cake mixes are on the grocery shelf today because scientists found out how to dry eggs that would hold their flavor in storage.

Boil-in-the-bag frozen foods containing gravies and sauces are also a result of food research. USDA studies led to the development of starch- and egg-thickened sauces, gravies, salad dressings, and desserts.

Annual sales of frozen vegetables and meats with sauces and gravies have already topped the $200 million mark. By 1968, a fivefold increase in sales is expected.

Science Updates Your Favorites

Nothing is more American than lemonade on the Fourth of July or turkey and pumpkin pie on Thanksgiving. We still serve these delicious, traditional foods, but much of the time and work of preparation is gone.

Now presweetened frozen lemonade concentrate reconstitutes into lemonade with the addition of cold water. No more squeezing of lemons, no more inedible waste. You save money and work.

USDA graded turkeys come large or small, frozen or ready-to-cook, stuffed or unstuffed, as you like. Family-sized, meatier birds were made possible by agricultural research.

Improved transportation and marketing techniques make turkey available the year round. You can get boneless turkey roasts made from all white meat or a combination of white and dark meat. They cook quickly, slice easily, and taste delicious. If you prefer, you can buy fully cooked turkey that you need only reheat and serve.

More than a fourth of all turkey meat going into processed food products is now being used for turkey roasts or turkey rolls. These highly popular convenience foods come preseasoned, and, in many cases, in their own foil roasting pans. The USDA recently developed a grade standard specifically for turkey roasts—so look for the turkey roast bearing the USDA grade shield.

Gone forever are the days when preparing the royal bird was a laborious, time-consuming job!

About the pumpkin pie. If you don't want to make the crust yourself, you can use a pastry mix, pie-crust sticks, or a frozen crust already in the pan. For the filling, canned pumpkin comes with or without the spices added.

Now pumpkin powder—made from pure pumpkin puree a product developed by agricultural chemical engineers—is coming. The powder can be mixed with eggs, seasonings, spices, and other ingredients to make a quick pumpkin pie filling.

These exemplify a myriad of convenience foods from USDA and other agricultural laboratories. You and your family enjoy them at breakfast—luncheon—dinner—and snack time.

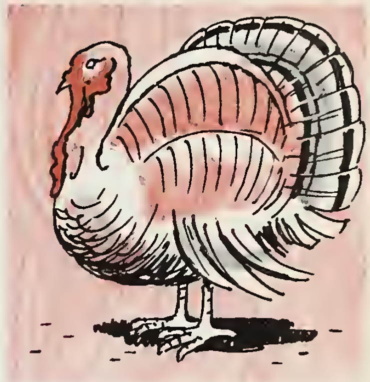
Convenience Foods From Agricultural Research

Instant sweetpotato flakes reconstitute to cooked mashed potatoes in 3 to 5 minutes with the addition of hot water or milk. Add spices and seasonings, and top with marshmallows for a quick casserole.

For a hot beef sandwich in 8 or 10 minutes, drop frozen boil-in-the-bag beef slices and gravy into boiling water.

Here is a partial list—

- Frozen fruit juice concentrates.
- Low-cost broilers; fryers cut up, ready to cook.
- Flavor-true soybean oil that doesn't deteriorate in transit or in storage.
- Dry beans that are ready to serve in only 30 minutes.
- Protein-rich peanuts with reduced calories.
- Full-flavored berry powders for ice creams, sherbets, sauces, and pastries. Choose from blueberry, boysenberry, strawberry, raspberry, or blackberry flavors.
- Dry apple flakes for use in cake and dessert mixes and in candy.
- Potato flakes that make fluffy mashed potatoes by simply adding hot water or milk, plus butter and salt.
- Freeze-dried strawberries, blueberries, peaches for use in packaged dry cereals; freeze-dried mushrooms for gravies, soups, and seasonings.
- Sweetpotato flakes that reconstitute in 3 to 5 minutes for addition to casseroles and puddings or as a filling for that Southern delicacy—sweetpotato pie.
- Frozen apple juice superconcentrate.



Boneless turkey roasts are available in their own foil pans—ready for roasting. Slice cooked turkey and serve, hot or cold.

Clothes That Press Themselves

You feel new comfort and freedom in many of today's cotton clothes. The magic is stretch cotton, another new product of agricultural research.

Shirts, shorts, slacks, even summer suits, "give" without bagging. They're available in plain fabrics or knits. What's more, the stretch holds through dozens of washings!

Now, there's stretch in machine-made cotton lace. It's ideal for fitted slips, foundation garments, lounging and sleepwear. The new treatment gives richness—and a three-dimensional texture—even to inexpensive cotton lace. It's handsome enough for formal dresses and wraps.

Carefree Cottons

Everyone likes wash-wear finishes that reduce wrinkling and save ironing. Agricultural chemists laid much of the groundwork that made wash-wear finishes commercially possible. They developed two superior wash-wear finishes widely used today in the textile industry.

Here are other advantages agricultural research has built into cotton—

- Increased resistance to water, stains, and mildew.
- Minimum shrinkage and fading.
- Brighter colors, whiter whites, more luster.
- More permanent pleats and creases in wash-wear cottons.
- Better cotton batting for mattresses and automobile seats.
- Molded cotton fabrics . . . simplify construction of upholstery, hats, women's shoes, and brassieres.
- A new colorless weather-resistant finish for outdoor cottons . . . gives longer life to awnings, beach and patio umbrellas, and tents.
- Resistance to flame. Suits with built-in fire resistance are worn by our firemen and handlers of missile fuels. Flame-retardant cottons are also being used in hospitals for cubicle curtains, for thermal blankets, and for gowns and sheets in operating and patient rooms where oxygen is administered. Many children now go trick-or-treating in Halloween costumes treated for fire resistance.

What's Working for Wool

When the Prince of Wales made creases in men's

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Scientists gave cotton a new dimension—stretch—for added comfort and easy care.

The model, shown in the wool processing laboratory at Albany, Calif., wears a machine-washable wool blouse and skirt. She holds a strand of "top"—an experimental blend of wool and cotton.

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trousers fashionable in the 1860's, no one dreamed the time would come when wool trousers could be tossed in the home washer and emerge sharply creased.

Yet today agricultural chemists can set durable creases and pleats into treated wool.

Treated wool already has scored a big success in machine-washable sport shirts, women's and children's wear. And it has been approved for durable pleating of Armed Forces uniforms.

Durable pressed slacks, pleated skirts, and shirts will reach the consumer first, followed by suits for men and women.

Textile specialists have built other conveniences into modern wool fabrics. You already enjoy—

- Increased wrinkle- and soil-resistance.
- Minimum shrinkage.
- Longer wear.
- Mothproofing and dyefastness.
- Greater sheerness and luster.

Know-How on Stains and Sanitation

Clothing and textile scientists do more for you than improve your fabrics. They also help you take better care of your clothes. They study soaps and detergents, bleaches, and mending techniques. They tell you how to remove stains, mildew, and harmful bacteria from clothes.

About stain removal. A popular bulletin has the right answer for most common stains in clothing and household textiles. It rates in the top ten among all U.S. Department of Agriculture publications.

About harmful bacteria. Textile bacteriologists proved that harmful bacteria can survive most home laundering methods. Clothing, towels, even the washing machine itself, can spread bacteria that infect your throat, skin, kidneys, or that upset your stomach.

By adding a suitable disinfectant during laundering, you can reduce the total number of bacteria to a safe level. Disinfectants are inexpensive, and do not damage fabrics.

Blueprints For Living

Your home—like the foods you eat and the clothes you wear—is no longer bound by old concepts. You and your family live more casually and enjoy more leisure. You like to cook out, camp out, and have fun in the sun.

Mobility is a sign of the times. So is insistence on comfort and convenience. Housing today has to be functional and flexible. Time- and labor-saving features are almost taken for granted.

Agricultural research engineers and architects, along with home economists, are helping shape these American patterns of living.

Living Ideas, Big and Small

If you're planning a house, an addition, or a remodeling, research information can help. This goes for a home of your own . . . a super kitchen . . . a vacation cabin . . . a retirement apartment . . . a boat landing . . . a linen closet . . . or a home fallout shelter.

This help is available in building plans and how-to publications.

Since 1929, agricultural research has developed some 250 house plans. Approximately 30,000 of these house designs are distributed each year.

The U-shaped kitchen, a USDA innovation, aroused national and international interest. Women everywhere hailed its convenience, asked for more. Other energy-saving kitchen and workroom designs, based on time and motion studies, followed.

Thirteen house planning leaflets, completed in 1965, offer help for specific areas—bathrooms, bedrooms, dining rooms, kitchens, and storage facilities throughout the house. More than half a million copies have been distributed.

Research to the Rescue

One urgent need today is more low-cost housing. Another is more housing for the elderly—the fastest growing group in our population. Agricultural research is at work in both of these problem areas.

- Survey and guidance in housing for migratory farmworkers. This 4-year project, now in its third year, reaches one of our most neglected groups.
- Two new house plans for senior citizens.
- A 24-page bulletin for one- and two-bedroom units that combine into multi-unit retirement housing. Arrangements emphasize safety, ease of moving about, and energy-savers. Construction costs are kept low so rental or purchase price will fit limited budgets.
- Urban apartment units designed for older people—especially those on low incomes.

Many Fringe Benefits

Other consumer helps from engineering and housing research include—

- Studies that point out what to look for in buying household appliances—how long you can expect them to last—and how to fit their purchase into the family budget.
- Development of low-cost, spray-on insulation

This A-frame cabin makes an ideal vacation headquarters for families who like to hunt, fish, ski, or just enjoy the great outdoors. Agricultural architects and housing specialists designed the easy-to-build unit, which has three bedrooms, 1,108 square feet of floor space, and a modern kitchen.

naterials from certain farm crops.

- Performance tests on household appliances hat resulted in improved standards and convenences in refrigerators, electric and gas ranges, reezers, water heaters, dishwashers, and hand rons.

Research and recommendations on full and efficient use of modern home laundering equipment.

- Standards for heights of work surfaces and storage areas in the home.

Agriculture That Saves Lives

Antibiotics and agriculture may seem strange allies, but they are linked in one of the most spectacular medical advances of the 20th century.

A mass prooduction technique—developed by agricultural microbiologists—is the foundation of today's multimillion-dollar antibiotic industry. It's the big reason you can get these lifesaving drugs at a reasonable price.

It began with an urgent appeal to USDA laboratories to help produce penicillin during World War II. The world desperately needed a less costly way to grow penicillin in quantity.

A laboratory staff member discovered a more productive strain of penicillin that became the parent of all present-day cultures used to grow penicillin.

Within record time, scientists developed a production medium—from fermented corn waste and milk sugar—that increased the yields of penicillin many fold. It made large-scale production of penicillin and other antibiotics possible.

Wartime needs often spark discovery. Here are similar examples from agricultural research.

A threatened typhus epidemic in war-torn Italy in 1943 was stopped cold because an agricultural laboratory developed a louse-control method using DDT.

Dextran, a blood plasma extender first used during the Korean War, still saves lives on battlefields and in hospitals. Clinical dextran costs one-fourth as much as blood plasma, and can be sterilized and stored without refrigeration.

Today a leech-repellent, perfected by agricultural entomologists, protects our servicemen from land and water leeches in the jungles of Vietnam.

Conquest of Cancer

Agricultural research workers seek answers to cancer growth and control on many fronts. Botanists search the world for extracts from plants that may inhibit cancer.

Spanish moss from Florida and a giant tree lily from Ethiopia are among hundreds of species under test. Presently, a substance extracted from an obscure Chinese tree shows promise of arresting leukemia in humans.

Poultry pathologists were among the first to discover that a virus can cause cancer. Continued research on avian leukosis, a form of cancer in poultry, may help solve the riddle of human cancer.

Everyday Protections

Some health benefits from agricultural science are the home- and neighborhood-kind.

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An agricultural chemist used monkeys from the Philippine Islands as stand-ins for humans in developing a highly specific, risk-free test for detecting human allergies.

The rabies shot the veterinarian gives your dog is safe and effective because of the work of USDA inspectors. Regulatory workers test and inspect the chemicals that purify your drinking water . . . and the germicides that keep your kitchen, bathroom, and swimming pool clean and sanitary.

Recent Health Benefits

Human brucellosis or undulant fever, seldom heard of today, affected thousands of persons in the late 1940's. There were 257 cases in 1965, compared with 6,000 in 1947.

This amazing decline is a result of a nationwide USDA campaign to eradicate brucellosis from cattle and hogs. Today less than 3 percent of the cattle herds and 1 percent of the cattle in this country are infected. The goal for eradication: 1975.

Other discoveries, announced by agricultural scientists in 1966:

- A high-calorie fat emulsion that offers new hope in intravenous feeding. Made from cottonseed oil, the new emulsion provides eight times as many calories as solutions now used. This could help overcome weight loss in critically ill patients.
- A pasteurization process for raw egg products —a step in the control of salmonella food poisoning, a common malady that causes enormous time loss in man hours and productivity in this country.
- A new process for tanning sheepskins with the wool left on, produces shearlings that make cool, comfortable, easily laundered padding for beds in hospitals and nursing homes where bedsores are a vexing problem.

Milestones for Mankind

Agricultural science protects your health in many other ways.

Here are some historic highlights:

- Discovery that ticks carry Texas fever and other diseases to livestock. This led to the development of the weapons that the world uses to protect man from diseases carried by insects.

Included are: Malaria, yellow fever, and encephalitis carried by mosquitoes; typhoid and other diseases carried by flies; and typhus carried by lice.

- Elimination of tubercular meningitis, hunchback, and other forms of bovine tuberculosis in man, following the reduction and control of this disease in dairy cattle and the pasteurization of milk.
- Development of a risk-free and highly specific test for human allergy.
- Equipment that can remove more than 90 percent of radioactive strontium from milk. This assures you a safe and palatable milk supply in case of nuclear attack.
- Creation of the aerosol bomb to apply insecticides and the extension of aerosol containers to dispense a multitude of consumer products, including house paint, hair spray, shaving cream, waxes, and deodorants.

The War On Pests

Soon you may be using discarded TV dinner plates or a mulch of aluminum foil to spirit away aphids from your rose bushes, houseplants, and young vegetable plants.

Aphids—the tiny, green-to-black sucking insects that severely damage flowering plants and vegetable crops—don't like the intense reflective light from aluminum foil. They usually fly right over it.

USDA entomologists found the aluminum foil technique more effective than any insecticide in controlling aphids. Aphids carry a number of viruses deadly enough to destroy an entire crop. Another big plus —no pesticide residue.

Insects on the Inside

Household insects—particularly cockroaches, ants, and carpet beetles—have an incredible ability to thrive and multiply.

In battling these home invaders, research is your greatest ally. It has made possible publications that tell you what common household insects look like, what they do, and how to control them. There's even help in deciphering the complicated names of pesticides.

Points of Progress

Every American consumer benefits directly or indirectly as USDA scientists redouble efforts to find more effective—and safer—ways to control pests.

Now and in the foreseeable future, people need the proection of pesticides. Without this protection, you and your family would face food shortages —even famine.

Without pesticides, our whole population could be threatened with some 50 diseases that are carried by insects. In countries where insects are uncontrolled, thousands still die from malaria, typhus, sleeping sickness, and yellow fever.

Some pesticides may leave harmful residues when improperly used. Agricultural science is battling to rid our whole environment—air, water, soils, and foods—of these residues.

One approach is through alternate methods of controlling insects—with other insects or microorganisms, by breeding insect and disease resistance into crops, with natural attractants to lure insects to poison baits, or by sterilizing insects and preventing their reproduction.

On the small percentage of our land treated with pesticides each year, the job of preventing pesticide residues is government-wide. Agricultural scientists play a vital role. They monitor soils, water, crops, livestock, beneficial insects, and aquatic and land animals where pesticides are used.

Where levels of pesticide residues are found to be higher than legally permissible, corrective measures can be taken immediately.

Every pesticide marketed in interstate commerce must be registered. Each pesticide must do what the label says it will do—and be safe when used as directed—before it can be registered.

Department inspectors regularly check pesticide products sold in retail stores. They make sure that these products continue to satisfy registration requirements.

Keeping Hitchhikers Out

Once every 16 minutes around the clock, USDA inspectors intercept a significant foreign pest at our principal ports of entry.

Today more people travel more, farther, and faster. The danger of damaging foreign pests and diseases destroying our agriculture is greater. Without the services of highly trained quarantine officials, your food supply would be constantly threatened.

Food Facts versus Food Fads

Pick up the food section of your newspaper. Competing for your attention are recipes to tempt the appetite and advertisements for drugs to reduce the appetite. Claims for reducing schemes and food supplements challenge information in food columns.

Turn on your television set. You hear the din of commercials selling vitamin capsules, cure-alls, low-calorie drinks. All claim to give you health and vitality—to keep you slim, trim, and forever young.

Food faddists and health promoters are having a field day. People in the United States spend more than $500 million a year on unnecessary or falsely represented vitamin products and so-called health foods.

Where do you turn for truth and guidance? What foods are good for you and why? Just what is a balanced diet?

USDA human nutritionists already have supplied many of the answers. Since 1894, biochemists and nutritionists have been seeking, finding, and reporting scientific knowledge about nutrition to the American people.

Variety and Moderation

Science's answer to the diet peddlers is simple. The best way to keep healthy is to—

- Eat a variety of well-chosen foods every day.
- Eat moderately.

Too many Americans are eating and drinking too many calories for desirable weight and good health.

All the nutrients your body needs are amply supplied in a variety of foods at your supermarket. All the known food elements, vitamins, and minerals are there—the four basic food groups that can bring health, vitality, and well-being.

Nutritionists say you need foods from the vegetable-fruit group—the meat group—the milk group—and the bread-cereal group every day to assure a balanced diet.

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A biologist studies body tissue through an electron microscope to determine the effect of diet on tissue. Long-term nutrition research is underway to learn how body function and length of life are affected by diet.

To help you make a wise selection of foods, they prepared the widely distributed USDA leaflet, "Food for Fitness: A Daily Food Guide." It presents the basic food groups that provide essential nutrients. It recommends the amounts needed daily by different age groups and for different activities.

This easy-to-follow guide condenses the best and latest knowledge on how to get a balanced diet. It's that simple!

Actually, the body needs only certain amounts of the essential nutrients for proper functioning. Any excess, with the exception of fat-soluble vitamins A and D, is not utilized. Money spent for high-potency vitamins and supplements is often wasted.

The overall nutritional status of a person determines to a large extent his susceptibility to certain diseases. No one food can be considered a cure or treatment for such diseases. Your physician is the only reliable source of advice for proper treatment.

Facts on 2,500 Foods

Today millions of people throughout the world benefit from food composition tables prepared by nutrition analysts in the USDA.

These food tables—the most authoritative and comprehensive ever assembled—contain facts on calories, vitamins, 18 different nutrients, and other food components. More than 45,000 separate values are included for approximately 2,500 food items.

Food composition tables are indispensable to dietitians, teachers, and the medical and nursing professions. Industrial laboratories, welfare agencies, publishers, and foreign food programs make wide use of them. When you count calories, you use calorie values calculated by the USDA.

Services From Food Science

• **Nationwide food surveys to find out what Americans eat.** The fifth survey—completed in 1966—includes facts about the foods eaten by 15,000 families; and, in addition, the foods eaten by 13,000 individuals during four seasons of the year.

The data, the most complete ever gathered, pinpoints trouble spots in our eating habits. We know that overweight is our number one nutritional problem. But it isn't enough to know overall trends. We need to know the diet patterns of different age groups.

Hopefully, the survey will help answer questions like these. . . . How can the food habits of America's office workers be changed to fit their physically inactive, pressure-driven way of life? . . . Are teenagers eating balanced diets? . . . What about our overweight school children? . . . Do elder citizens get enough meat, milk, fruit, and vegetables to sustain vigor?

• **Development of recipes for the School Lunch Program.** About two out of three children attending elementary and secondary schools in the United States get school lunches.

• Cooperation with the Office of Economic Opportunity in **helping disadvantaged families get better diets.**

• **Testing and recommendations of food preparation and food preservation methods** that best maintain eating quality, safety, and nutritive values in food.

A More Colorful America

Look out the window—at home, at the office, on your way to work. Scan your neighborhood, lawn and backyard. What you see is your daily view of America.

If you live away from green, growing things and a share in their growing, your daily view of America can be drab—without delight or renewal.

Now, a groundswell in the American community aspires to beautify our surroundings . . . to protect and expand our parks, shelterbelts, and camping areas . . . to preserve the grace and solitude of the countryside . . . and rightfully, to share this beauty with those who have been denied it.

Agricultural science has a big responsibility in the beautification program. Plant scientists, crop research workers, soil and water conservationists, foresters, and entomologists are reshaping studies and plant collections to help in every way possible.

Search for Greenery

City and local governments and park authorities have joined homeowners in demands for shade and street trees and hardy ornamentals. Improved lawn grasses and quick-growing cover crops are badly needed, too.

Trees in an urbanized society have to be tough. They must survive smog, bad treatment, inadequate root space, uncertain moisture, insects, and disease.

To help color America green, agricultural scientists are developing—

- Rapid-growing trees and shrubs for temporary use and quick shade.
- Pest-resistant ornamental plants, and ornamentals adapted to broader regions.
- Improved lawn grasses that need little water and maintenance.
- Plant varieties that withstand cold winters, extreme summers, and drought.
- Cover crops and flowering perennials for eroded areas and highway embankments.
- Safer and more effective weedkillers.

So People Can Plant

Research alone cannot beautify the face of America. It takes planning, work, and, most of all, know-how. Whether your project is a public park, a suburban rock garden, or a flower box for a city window, you need information!

Getting the facts about crop and plant research out to the people who put it to work is the job of USDA information services. This means informing home gardeners and backyard flower growers, as well as farmers with hundreds of acres.

Practical, how-to bulletins and leaflets are a mainstay in helping people select, plant, protect, and grow trees, shrubs, and flowers. Scores of horticultural publications are already widely distributed.

And even more help is coming your way. New publications will tell of shrubs for shady places, tree culture, automatic lawn watering, home propagation of ornamentals, and protecting shade trees during home construction.

Looking Ahead

Home gardeners and flower growers will be in-

terested in these research leads and suggestions—

• Roses free from fungus. Blackspot—a fungus disease that plagues rose growers—may soon be overcome by crossing an artificially altered multiflora rose with garden varieties.

• Loosely woven cloth treated with weedkiller may prove the safest and most convenient way to apply herbicides to small gardens. Treated cloth worked well with 14 herbicides in USDA tests.

• Coming nearer—a tonic that delays aging in cut flowers. Small dosages of ethylene oxide gas retarded aging in cut carnations and roses in tests at Beltsville, Md.

• A petroleum oil spray on lateral buds of chrysanthemums aborts their growth and helps develop big, beautiful blooms on the terminal (top) bud. This may eliminate hand removal of lateral buds.

• Flowers on the hour . . . plant scientists have successfully regulated flowering of annuals and perennials by using chemicals and manipulating light.

• A tip from research workers is to "irrigate" houseplants with a length of plastic tubing set in each pot. Water poured through the tube reaches the soil through four ⅛-inch openings . . . does a better job than surface watering. Suitable tubing is available at many garden and dairy stores, plant nurseries, or hardware stores.

• Homeowners over America eventually will share a rare collection of dwarf evergreens planted recently at the National Arboretum. Cuttings from the tiny trees are being distributed to other arboretums and cooperating nurseries.

ST–884–3

Cloth treated with a weedkiller shows promise as a safe and easy way to apply herbicides to small garden plots. Loosely woven cloth on a roll (left) has been pretreated with controlled amounts of herbicide. Herbicide-treated cloth is cut to fit the area to be treated and then put in place. Edges are anchored or the cloth is covered entirely with a thin layer of soil. The cloth rots away in a few weeks.

meanwhile, Back in The Laboratory

Two great challenges face agricultural science.

First, it must serve American consumers. The 21st century will see the U.S. population more than doubled. Needs for food, fiber, and shelter will double. Because farmers and scientists have made agriculture abundantly productive, we do **not** have a food supply problem now. We need—and have—adequate reserves.

Second, agricultural abundance and know-how must help meet the challenge of an exploding world population, much of which is plagued with hunger and disease. Agricultural science is making an effort to find new protein foods for people whose diets are mainly cereals—who may get less protein in a year than many Americans consume in a week.

High-protein oilseeds—soybeans, cottonseed, peanuts—will help. High-lysine corn shows promise for Central America and South America. Increased production of dry beans, peas, and other large-seeded legumes—offers hope for the Middle East and South Asia. Wheat is doing its share, too. But research needs to find out how we can help more.

Self-help programs in developing countries have stepped up food production impressively, but even these gains are not enough to feed the ever-increasing numbers of people being born every year. Critical food shortages still exist in densely populated countries.

Another great need of these countries is a widespread transportation and marketing system to distribute food imports and to move farm products to ultimate consumers.

If mankind is to live in peace and freedom, people must be adequately fed. Time is running out.

Our consumer-science story necessarily ends on a "to be continued" line. Never in history have people been as dependent on science as now.

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